German Supervisory Board Size and Composition – A Detailed Evaluation of their Effects on Performance, Earnings Management and Cash Holdings

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Dipl. Oec. Andreas Bermig, MBA
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Abstract

The effects of board size and board composition on various measures of firm performance is a well researched topic in the area of corporate governance research; the main focus of this research has been on the US market but in the last years more research in other developed and developing economies has emerged as well. Research on board size does currently not exist for the German market, but board composition has been examined mainly regarding two unique characteristics of German supervisory boards: first, codetermination, i.e., the mandated employee representation, and second, the representation of bank employees on the board.

Based on the most comprehensive data set in German corporate governance research thus far, I consider the effects of board size and board composition on 1) market valuation and performance, 2) earnings management, and 3) cash holdings. The unique data set includes all major German listed companies from a ten year period (1998-2007, n=294, with some 2,400 observations).

The results of my analyses vary: while no consistent effect of either board size or board composition on firm valuation and performance can be found, the latter does have a significant impact on earnings management: female directors are associated with less earnings management. Eventually, I find lower levels of cash holdings for firms with smaller boards and with employee representatives on their boards.

The mixed results clearly show the limitations of empirical research in this area: these three outcomes suggest that board size and board composition should be considered carefully when structuring a company as well as when investing in certain firms. In contrast, the creation of a "general strategy" with regards to board size and composition is not advisable. These two conclusions of my research should be particularly considered when performing further research on this topic.

Zusammenfassung

Der Einfluss von Aufsichtsratsgröße und –zusammensetzung auf verschiedenste Größen der Unternehmensperformance ist vielfältig in der Forschung untersucht worden. Der Großteil dieser Forschung war bislang hauptsächlich auf dem amerikanischen Markt ausgerichtet. Erst in den letzten Jahren haben auch vermehrt Untersuchungen in weiteren Ländern stattgefunden. Während es keine Untersuchungen zur Auswirkung der Aufsichtsratsgröße für den deutschen Markt gibt, werden bezüglich der Zusammensetzung des Aufsichtsrats in deutschen Unternehmen hauptsächlich zwei Charakteristika betrachtet: Zum einen die Einflüsse von Mitbestimmung und zum anderen die Auswirkungen von Bankenvertretern.

Auf Basis des bislang umfangreichsten Datensatzes, der in der deutschen Corporate Governance Forschung verwendet wurde, untersuche ich die Auswirkungen von Aufsichtsratsgröße und –zusammensetzung auf 1) Marktbewertung und Unternehmensperformance, 2) Manipulation von Bilanzdaten und 3) Liquiditätslevel. Dieser einzigartige Datensatz enthält alle großen deutschen börsennotierten Unternehmen von 1998 bis 2007 (n=294 mit etwa 2.400 Beobachtungen).

Die Ergebnisse meiner Analysen sind sehr unterschiedlich: Während ich keine konsistenten Auswirkungen von weder Aufsichtsratsgröße noch Aufsichtsratszusammensetzung auf Marktbewertung und Unternehmensperformance finden kann, hat erstere erheblichen Einfluss auf das Management von Bilanzdaten: Weibliche Aufsichtsratsmitglieder werden mit geringerem Management von Bilanzdaten assoziiert. Weiterhin haben Firmen mit kleineren Aufsichtsräten und mehr Mitarbeitervertretern geringe Liquiditätsreserven.

Diese unterschiedlichen Ergebnisse meiner Analysen zeigen sehr deutlich die Grenzen von empirischen Untersuchungen in diesem Bereich der Corporate Governance Forschung auf: Sämtliche Ergebnisse legen nahe, dass sowohl Aufsichtsratsgröße wie auch -zusammensetzung genau betrachtet werden sollten, wenn man Entscheidungen diesbezüglich im Unternehmen zu treffen hat oder in diese investiert. Eine generelle Strategie an sich sollte jedoch nicht verfolgt werden. Beides sollte bei weiterer Forschung zu diesem Corporate Governance Thema beachtet werden.

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Last but not least, I would like to thank my mother and my sister for always being supportive and helpful during my efforts of this dissertation.

Andreas Bermig
München, December 2012

1. Introduction

Current newspaper headlines[1] in German newspapers indicate the importance and prevalence of corporate governance in public policy discussion:

"*Supervisory boards are clueless*" (Handelsblatt, July 10th 2009)

"*Corporate governance commission under pressure*" (Frankfurter Allgemeine Zeitung, June 20th 2009)

"*Supervisory boards caught in thicket of regulation*" (Frankfurter Allgemeine Zeitung, June 18th 2009)

"*The metamorphosis of supervisory boards*" (Handelsblatt, March 27th 2009)

"*Supervisory boards comply too fast to peer pressure*" (Frankfurter Allgemeine Zeitung, June 6th 2009)

"*Employee representation makes firms profitable*" (Frankfurter Allgemeine Zeitung, November 1st 2009)

"*More women and foreigners have to join supervisory boards*" (Frankfurter Allgemeine Zeitung, Mai 27th 2009)

Major German newspapers publish numerous articles per week on corporate governance. With regards to the supervisory board, topics of discussion mainly consider transition of supervisory boards to a more professional body that is better capable to diligently cater supervisory and consulting needs, especially in the wake of the current economic crisis. Thus, topics as the size of the board and its composition take a prominent role in the public policy debate.

Given this high attention of corporate governance regarding to supervisory boards in the public policy discussion for the past couple of years, it is surprising that academic research concentrating on board size and board composition has just recently picked up in the German

1 These headlines are translated from German language and adjusted in wording to best represent the meaning of the original statement

market. Based on the shortcomings as well as the gaps of prior research, I address the effect of board size and board composition in three areas in this thesis: firm valuation and firm performance, earnings management, and cash holdings.

The first topic – the effect of board size and board composition on firm performance – is the most thorough researched area both internationally and in the German market. While prior research on the US market mainly finds a negative relation between board size and firm performance, i.e., smaller boards are considered to be more effective in reaching decisions and monitoring (e.g., Yermack (1996), Eisenberg, et al. (1998)), no research of board size and firm performance has been available for the German market. The lack of research is mainly due to the fact that board size for German corporations is largely set by law, according to the firm's statuary capital and number of domestic employees. As the law only requires a minimum number of board members firms indeed have flexibility with regards to their board size, which is also apparent in my extensive data set – at least 24-28% of all firms have a larger board than required by law[2] (this is also confirmed by Gerum and Debus (2006)). Considering board composition, research on German boards is more elaborate than research on US boards; this is due to the fact of mandated employee representation (codetermination) in German supervisory boards. Therefore, the role of employee representatives in boards has been researched numerous times for the German market while research on the US market mainly considers the independence of directors (e.g., Hermalin and Weisbach (2003), Adams and Ferreira (2007), Bange and Mazzeo (2004)). While research on codetermination in Germany has been performed for a long time (e.g., Baums and Frick (1998), Gorton and Schmid (2000)) many authors (e.g., FitzRoy and Kraft (2005)) criticize that only few empirical studies on codetermination exist and that many of these studies have shortcomings based on the data or methodology used (e.g., by using cross-sectional data which does not allow to control for firm-specific effects). Thus, I aim to fill this gap by using the most comprehensive data set used in German corporate governance research to date (see description in section 4). Aside from firm performance the effect of board size and composition on other measures has not been considered thus far for the German economy.

2 Due to the fact that we only have the total number of employees (including international employees) as a basis for calculations of the required board size and the law bases the board size on domestic employees, this percentage is likely to be higher.

The second topic concerns the effect of board size and board composition on earnings management. It is quite surprising that there is little research for the German market as earnings management itself is a highly discussed topic in the public debate. Aside from board composition in general, I research one aspect of board composition in more detail: the effect of female directors on earnings management. The first research in the area of corporate governance and earnings management dates back to 1996 (Beasley (1996)), when Beasly showed that firms with no fraudulent accountings have a higher share of outside directors. Further research in this area suggests that also smaller boards and boards with members with corporate and finance backgrounds are associated with less earnings management (e.g., Klein (2002), Xie, et al. (2003), Cornett, et al. (2008)). Regarding literature on gender diversity referring to earnings management and corporate governance only few studies are available: While one article is available on gender diversity and earnings management for the US (Parsons and Krishnan (2006)) find that gender diversity is positively related to earnings quality), slightly more work is available on corporate governance and gender diversity in general; once again the focus of this work has been the US market: Carter, et al. (2003) find a positive relation between percentage of women and ethnic minorities and firm value. Furthermore, Farrell and Hersch (2005) research the probability of the addition of a female director and most recent Adams and Ferreira (2009) find that female board members have a positive effect on board inputs, e.g., attendance, and firm outcomes. I aim to fill the gap of research on the German market with my second topic, again using the same comprehensive data set that is mentioned in section 4.

Eventually, I consider the third topic – cash holdings –, which is highly relevant in the context of corporate governance but has thus far not received much attention concerning the German market. Cash holdings have been of interest in academia for a very long time; Keynes already described in 1936 possible motives for holding cash (Keynes (1936)). Motives described by Keynes are nowadays considered a central part in the principal-agent conflict between shareholders and managers:

" *The problem is how to motivate managers to disgorge the cash rather than investing it at below the cost of capital or wasting it on organization inefficiencies*" (Jensen (1986), p. 323).

Further research on the US market mentions numerous ways to mitigate this conflict, e.g., by taking on debt (Jensen (1986)) or changing financial policy in general (Stulz (1990)). More recent research also considers stronger corporate governance as a way to reduce the cost of this conflict. Multinational studies argue that this conflict is less in countries with higher levels of investor protection (e.g., Dittmar, et al. (2003), Pinkowitz, et al. (2006)). Further research on the US market confirms that stronger firm-level corporate governance leads to lower cash holdings and higher valuations of excess cash (e.g., Dittmar and Mahrt-Smith (2007), Harford, et al. (2008)). Most studies on the European market focus on ownership concentration (e.g., Ferreira and Vilela (2004), Ozkan and Ozkan (2004)), but no research regarding to board size and board composition is available. In this case as well I aim to fill the gap in research and provide further insights.

Given the public debate and prior research on the above discussed topics, this thesis provides significant additions to the corporate governance research in general, and especially to the research on the German market leading to important implications for policy makers and further research.

2. Structure of the Thesis

This thesis consists of four self-contained articles covering the three above mentioned topics – researching the effect of board size and board composition on various dependent variables. While all papers have their own focus, they are based on the same comprehensive data set, which is described in the first of the four articles. This approach enables me to separately publish all of the articles in academic journals as well as the presentation of these articles at academic conferences[3]. One drawback of this approach is that some of the content with regards to the data set used and the institutional background are somewhat redundant or overlap in the four articles presented below. Furthermore, the second and third article (sections 5 and 6) are written in collaboration with Professor Bernd Frick and thus are written in plural voice.

The remainder of this thesis is structured as follows: Section 3 gives a brief overview over the unique institutional setting for German supervisory boards; the articles themselves are presented in section 4, 5, 6 and 7[4]. Finally, section 8 concludes with a summary and discussion of the results, managerial implications and directions for future research.

3 Thus far, the second paper has been presented by me at the Annual Meeting of the Academy of Economics and Finance 2010, Houston, USA, and at the 49th annual meeting of the Southwestern Finance Association 2010, Dallas, USA, a modified German version of it "Mitbestimmung und Unternehmensperformance: Der Einfluss von Arbeitnehmervertretern im Aufsichtsrat auf den Unternehmenswert" has been presented by Prof. Dr. Bernd Frick at the 13. Kolloquium *zur* Personalökonomie*,* Trier 2010 and at the Workshop der Kommission Organisation 2010 of the Verband der Hochschullehrer für Betriebswirtschaft (VHB) Berlin. This German version is accepted for publication in "Die Betriebswirtschaft". The second paper has been under review of the Academy of Management Journal and has unfortunately been rejected after the first round due to the fact that it was considered to be too empirical for the journal.

4 All articles are presented as submitted to the respective journals with the exception of the abstract, which has been omitted in this thesis, and the references, which are presented consolidated at the end of this dissertation.

3. Institutional Background

The German system of corporate governance differs fundamentally from the Anglo-American one: while the latter has a one-tier board structure, a publicly held German company (*Aktiengesellschaft*) has two boards: a management board (*Vorstand*), which is responsible for running the firms operations and setting its strategy, and a supervisory board (*Aufsichtsrat*), which has supervisory and consulting duties and sets the remuneration of the management board and appoints its members. In addition, the management board reports to the supervisory board and no member of each board can be a member of the other board at the same time. Eventually, an array of laws sets the minimum and maximum sizes of the German supervisory board as well as the composition requiring employee representation for certain firms[5].

Besides the differences in the setup, the German corporate governance system also differs significantly from the Anglo-American counterpart regarding its goal: the German system tries to take the views of all stakeholders into consideration when making corporate decisions (see Fauver and Fuerst (2006)) whereas the Anglo-American system mainly tries to mitigate agency problems and thus to maximize shareholders' wealth (Shleifer and Vishny (1997)).

5 More detailed information is set forth in the respective sections of the articles in section 5,6, and 7 of this the sis.

4. A Comprehensive Data Set on German Supervisory Boards

4.1. Introduction

Corporate governance is prevalent in public policy discussion in Germany. Major German newspapers currently publish numerous articles per week on corporate governance. With regards to the supervisory board, topics of discussion mainly consider transition of supervisory boards to a more professional body that is more capable to diligently cater supervisory and consulting needs, especially in the wake of the current economic crisis. Thus, topics as the size of the board and its composition are a focus of the public policy debate.

Board composition is one of the major concerns of the German corporate governance code commission; the most recent version of the German corporate governance code (Regierungskommission Deutscher Corporate Governance Kodex (2009)) has several additions that demand diversity, sufficient knowledge and an age cap, which is to be set by the respective firm. Furthermore, it limits the number of additional outside board memberships to three and sets limitations to impede the change of managing board members to the supervisory board.

The discussion of board size has been a heated one in the political arena: since the introduction of the European stock corporation (Gesetz zur Einführung Gesellschaft (SEEG), Bundesministerium für Justiz (2004)) in Germany in 2004, which allows companies to adopt the above mentioned legal form and set the size of their board according to their statutes. This enabled, for example, the largest German insurer Allianz to reduce their board from 20 to 10 members. During the election campaign for the German parliament in 2009 the German Liberal Party (FPD) even postulated a reduced board size for all corporations to 12 members (Freie demokratische Partei (2009)) along with the Federation of German Industries (as the BDI president Michael Rogowski expressed[6]: "*Supervisory boards, which are equally composed of employee and shareholder representatives, with up to 20 members are fairly ineffective*", Stern, December 21st 2004).

Given the high attention of corporate governance regarding to supervisory boards in the public policy discussion for the past couple of years, it is surprising that the academic research concentrating on board size and board composition has just recently picked up in the

6 Quote translated from German language

German market. To enhance current research in this area I compiled a comprehensive dataset, which provides detailed information on supervisory boards of the largest German listed companies.

4.2. Dataset

4.2.1. Description

Datasets used in previous research on German supervisory boards are mainly cross-sectional, i.e., not allowing to control for any changes over time (e.g., Fauver and Fuerst (2006), Gorton and Schmid (2004)). To enhance this shortcoming, the data set I collected is a time series and includes all publicly listed German companies that were listed for at least one year in one of the three main German stock market indices - DAX, MDAX, or SDAX; these are constituted of the German public companies with the largest market capitalization – during the period 1998-2007. Only those companies with at least two years of available data were included in the database. As I was not able to obtain annual reports for one or more years for seven companies, the initial sample consists of 2,476 observations from 306 companies.

The data set consists of all names, job titles, PhD titles, an indication if the member is chairman, vice chairman, employee representative, union representative, works council representative, bank representative, former managing board member, female, auditor or a lawyer. Furthermore, I collected information on the number of outside board memberships in the respective year[7] for each member and noted which union type and organization a union representative belonged to. All this data was consolidated on a firm and year level and then used as the basis for my research. In my various research efforts based on this data set I enhanced it by variables used as dependent and further explanatory variables such as firm performance (based on both stock market and accounting measures) and numerous accounting measures and further firm characteristics. Table 1 provides an overview and a description of the main variables used.

Table 1: Description of main variables

7 Both measured within the database, i.e., for all DAX, MDAX, SDAX companies, as well as provided in the annual reports

Variable	Name	Definition	n	Source
Tobin's Q	tobin_q	(Market capitalization + total assets - shareholder's equity) / total assets	2382	Worldscope/ own calculation
Total return to shareholders	tot_ret_ind	Indexed total return to shareholders (index set to 100 in first year) defined as: total return (t) = total return (t-1) * (price(t) / price (t-1))* (1+dividend yield)*(1./number of working days)	2382	Worldscope/ own calculation
Return on equity	roe	Return on equity - (Net Income before Preferred Dividends - Preferred Dividend Requirement) / Last Year's Common Equity * 100	2382	Worldscope
Return on invested capital	roic	(Net Income before Preferred Dividends + ((Interest Expense on Debt - Interest Capitalized) * (1-Tax Rate))) / Average of Last Year's and Current Year's (Total Capital + Last Year's Short Term Debt & Current Portion of Long Term Debt) * 100	2382	Worldscope
Supervisory board size	size	Size of supervisory board	2382	Annual reports
Share of union representatives	union_rep	Share of union representatives of total board members	2382	Annual reports
Share of works council representatives	woco_rep	Share of works council representatives of total board members	2382	Annual reports
Share of independent employee representatives	ind_rep	Share of independent employee representatives of total board members	2382	Annual reports
Share of bank representatives	bank_rep	Share of bank representatives of total board members	2382	Annual reports
Share of former board members	former_bm	Share of former managing board members of total board members	2382	Annual reports
Supervisory experience	experience	Cumulated number of further supervisory board memberships of all members in listed German companies (DAX, MDAX, SDAX) in respective year	2382	Annual reports
Total assets	log_assets	Logarithm of total assets	2382	Worldscope
Sales	sales	Net sales	2382	Worldscope
Industrial diversification	ind_diversifierd	Dummy variable, equals 1 if max. 90% of total sales are from one SIC-segment	2382	Worldscope/ own calculation
Geographical diversification	geo_diversified	Dummy variable, equals 1 if max. 90% of total sales are from one geographic segment (as defined by Worldscope)	2382	Worldscope/ own calculation
Competitive intensity	herfindahl	Sales-based Herfindahl-index based on 2-digit SIC industry-codes	2382	Worldscope/ own calculation
Blockholders with >25% holdings	block_25	Dummy variable, equals 1 if the cumulated share of blockholders (shareholders with >5% holdings) is larger than 25%	2382	Worldscope
Blockholders with >50% holdings	block_50	Dummy variable, equals 1 if the cumulated share of blockholders (shareholders with >5% holdings) is larger than 50%	2382	Worldscope
Blockholders with >75% holdings	block_75	Dummy variable, equals 1 if the cumulated share of blockholders (shareholders with >5% holdings) is larger than 75%	2382	Worldscope
Financial leverage	leverage	(Short term debt + long term debt) / total assets	2382	Worldscope/ own calculation
Investments/capital expenditures	capex_sales	Capital expenditures divided by net sales	2382	Worldscope
Operating margin	operating_margin	Operating net income divided by net sales	2382	Worldscope
Restructuring	restruct	Dummy variable, equals 1 if the company is in a restructuring phase	2382	Press search
Mergers and acquisitions	m_and_a	Dummy variable, equals 1 if the company is being taken over	2382	Press search

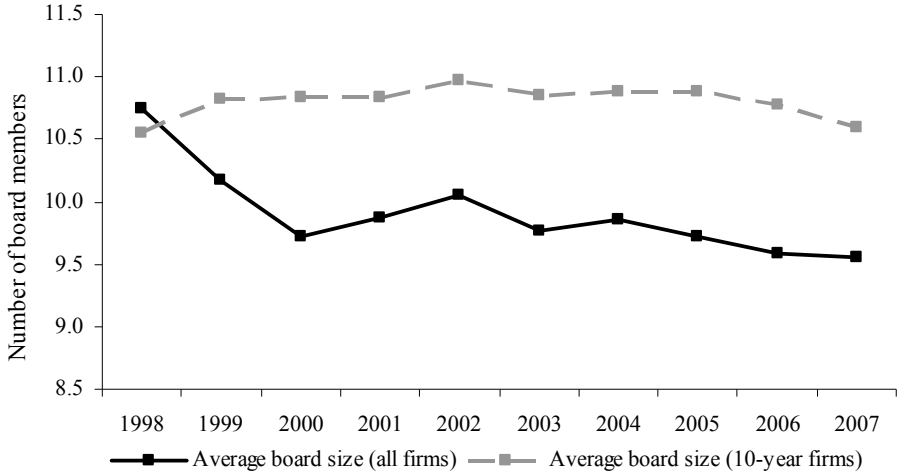
4.2.2. Sources

All data on supervisory board composition was hand-collected from annual reports of the respective firms. Reports not available from the company's website were obtained from the investor relations department, the annual report database of the *Schutzgemeinschaft der Kapitalanleger e.V.* as well as various archives in Germany (Archive of the Bavarian Chambers of Commerce, Archive of the University of Bremen, Archive of the University of Cologne). Finally, if no reports were available, data for supervisory board composition was assembled using the *Hoppenstedt Jahrbuch der Großunternehmen*. Measures of accounting performance as well as business and geographic segment data were obtained from Thomson Reuters Worldscope. Accounting data that was missing in Worldscope was taken from the companies' annual reports. The data on market capitalization comes from Datastream. Finally, I added information on specific company events (restructurings, mergers & acquisitions) following an extensive press search.

4.2.3. Descriptive Statistics

The supervisory boards of the largest German listed companies are subject to quite significant changes during the time period of my observation from 1998 to 2007. Especially with the introduction of the German corporate governance code and with changes in taxation (both in 2002), which allowed banks to divest their equity holdings without paying taxes on capital gains, the structure and composition of German supervisory boards changed. Another big change was the introduction of the European stock corporation (Societas Europaea) in 2004. These changes in the institutional landscape also had an effect on the size and composition of the supervisory boards: as Figure 1 shows, the average board size has declined from 10.7 members in 1998 to 9.5 members in 2007. This does not hold for the 156 firms, which are represented for ten years in my data set; the average board size first increases from 10.5 in 1998 to 11.0 in 2002 and then decreases again to 10.6 in 2007 – much likely due to the above described institutional changes in Germany.

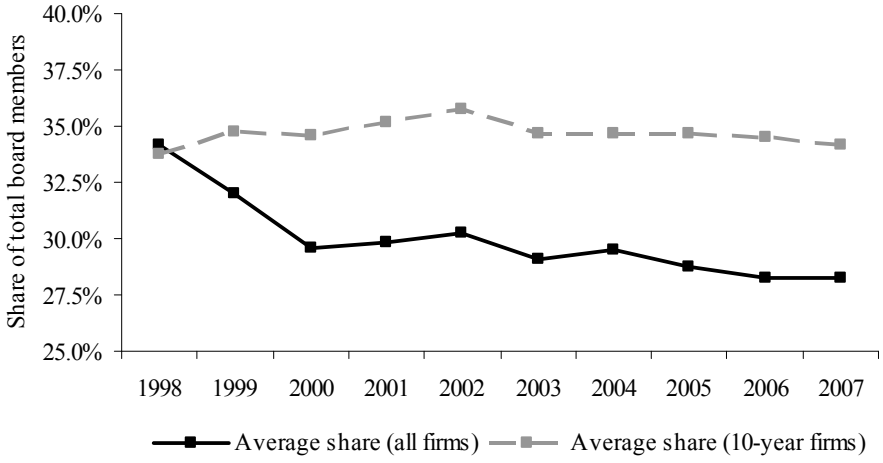
Figure 1: Development of average board members



Source: Annual reports

The same effect is visible when considering the share of employee representatives (see Figure 2): as the average share of total board members declines from 34% in 1998 to 28% in 2007. Once again, the same does not hold for the 10-year firms as the share of employee representatives is about stable at 34% (with a peak of 36% in 2002).

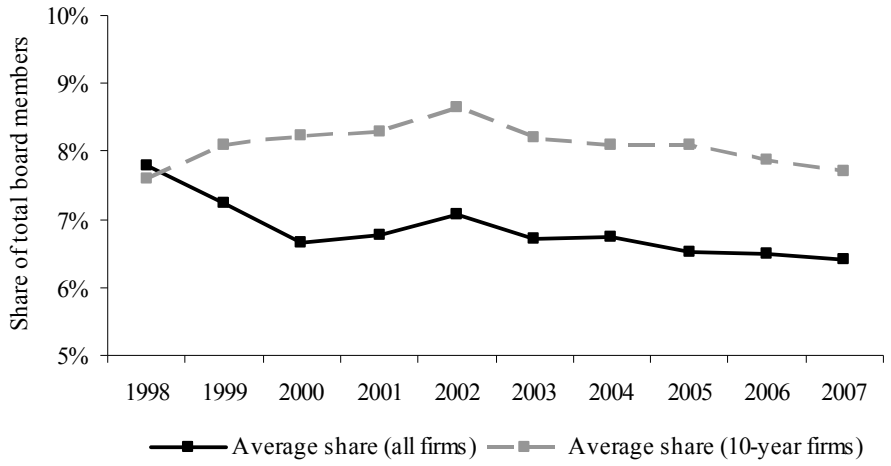
Figure 2: Development of employee representatives



Source: Annual reports

The development of increasingly smaller boards with less employee representatives is also apparent, when considering the share of union representatives, which is also declining (as shown in Figure 3).

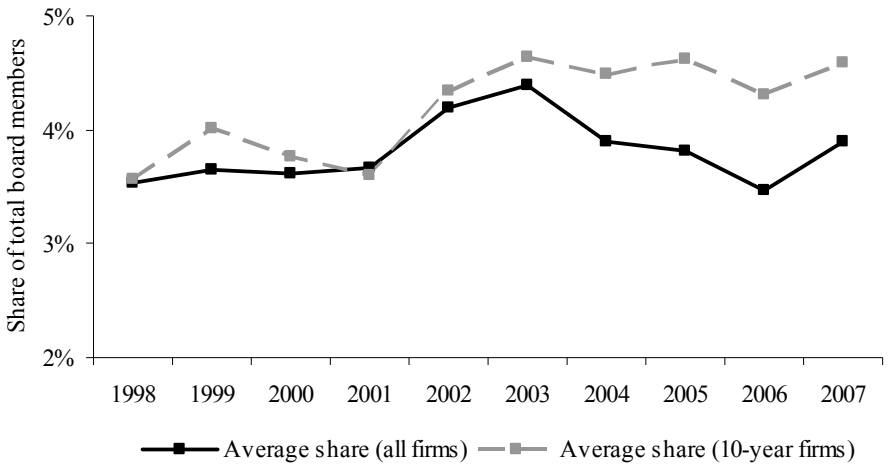
Figure 3: Development of union representatives



Source: Annual reports

One central postulation of the German corporate governance code (Regierungskommission Deutscher Corporate Governance Kodex (2009)) was to limit the influence of former managing board members which usually "moved" up to the supervisory board after their term in the management board had ended. To provide a more independent view and to weaken "old boys" networks, the code suggests that "*Management Board members may not become members of the supervisory board of the company within two years after the end of their appointment unless they are appointed upon a motion presented by shareholders holding more than 25% of the voting rights in the company*" (German Corporate Governance (2009): 10). The reality shows a different picture though: as Figure 4 shows the share of former managing board members has risen for both all firms as well as the 10-year firms. While it increased from 3.5% to 3.9% for all firms, it rose even more for the 10-year firms from 3.6% to 4.6%.

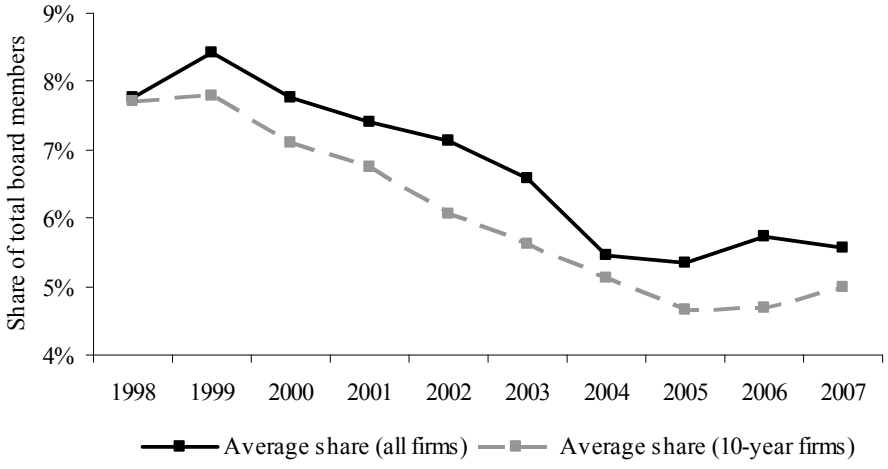
Figure 4: Share of former managing board members



Source: Annual reports

One area where the institutional changes are very obvious, is the share of bank representatives; as Figure 5 shows the share declined for both the entire sample as well as for all 10-year firms; the share for all firms decreased from 7.8% in 1998 to 5.6% in 2007.

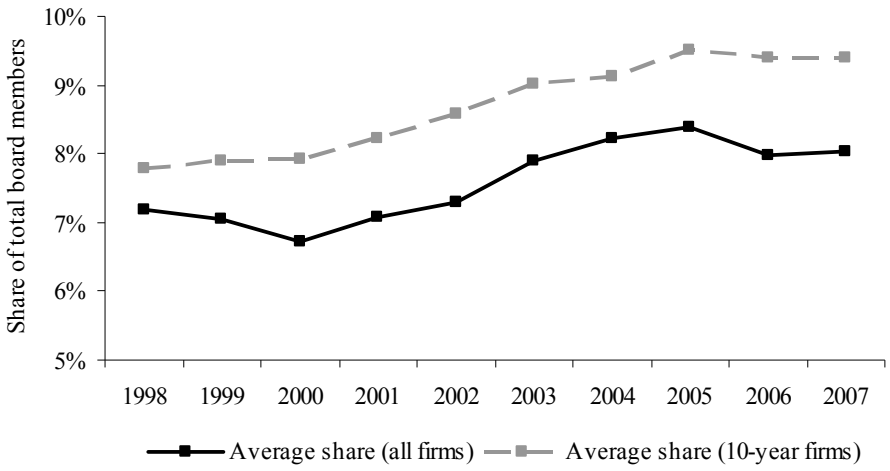
Figure 5: Share of bank representatives



Source: Annual reports

While share of female board members in German supervisory boards has increased as well (from 7.2% to 8.0% for all firms), it still lags behind the international average, and is at about average in Europe (see section 6.2. for more detail). It remains to be seen if the recent change to the German corporate governance code (in the latest version of June 2009 the code now includes that "*attention shall also be paid to […] diversity*") will cause more significant changes to the share of female directors.

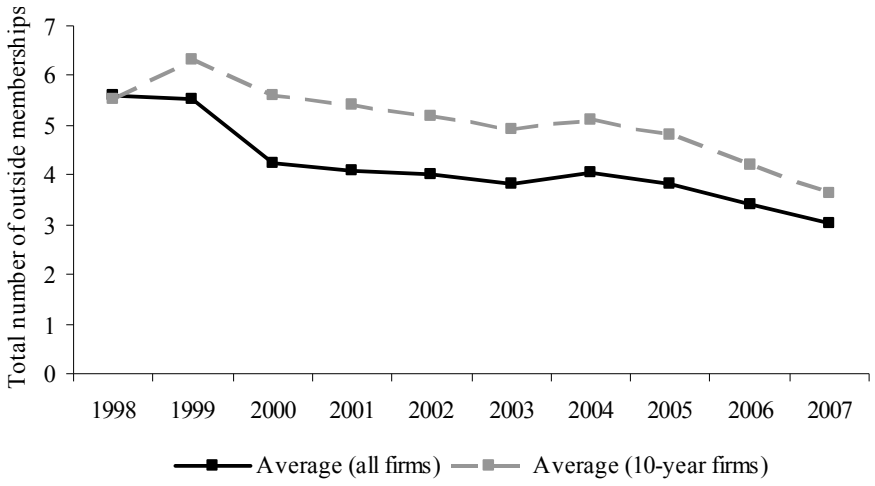
Figure 6: Share of female board directors



Source: Annual reports

Another area where the German corporate governance code has been effective is the number of outside supervisory board mandates. The code suggests that "*Members of the Management Board of a listed company shall not accept more than a total of three Supervisory Board mandates in non-group listed companies*" (Regierungskommission Deutscher Corporate Governance Kodex (2009), p. 10). As Figure 7 shows the number of outside supervisory board memberships has decreased from 5.6 to 3.0 for all firms in the dataset (the average has decreased from 5.5 to 3.6 for all 10-year firms).

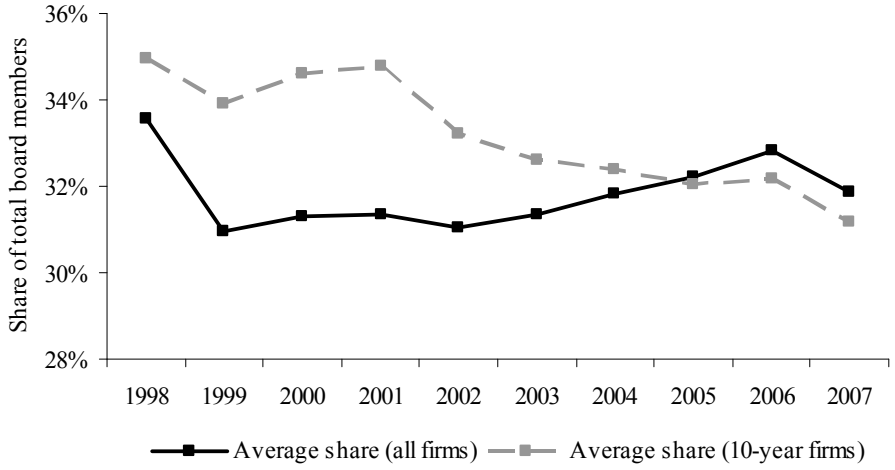
Figure 7: Number of outside board memberships



Source: Annual reports

Finally, the share of board members with PhDs (which includes honorary PhDs) has also decreased in recent years (from 34% to 32% for all firms – see Figure 8) but remains relatively high with 32%.

Figure 8: Share of board members with PhDs



Source: Annual reports

All of the above mentioned characteristics of German supervisory boards are again summarized in Table 2.

Table 2: Composition of German supervisory boards

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Average board size										
All firms	10.7	10.2	9.7	9.9	10.1	9.8	9.9	9.7	9.6	9.5
10-year firms	10.5	10.8	10.8	10.8	11	10.8	10.9	10.9	10.8	10.6
Share of employee representatives										
All firms	34%	32%	30%	30%	30%	29%	30%	29%	28%	28%
10-year firms	34%	35%	35%	35%	36%	35%	35%	35%	34%	34%
Share of union representatives										
All firms	8%	7%	7%	7%	7%	7%	7%	7%	7%	6%
10-year firms	8%	8%	8%	8%	9%	8%	8%	8%	8%	8%
Share of former managing board members										
All firms	3.50%	3.60%	3.60%	3.70%	4.20%	4.40%	3.90%	3.80%	3.50%	3.90%
10-year firms	3.60%	4.00%	3.80%	3.60%	4.30%	4.60%	4.50%	4.60%	4.30%	4.60%
Share of bank representatives										
All firms	7.20%	7.00%	6.70%	7.10%	7.30%	7.90%	8.20%	8.40%	8.00%	8.00%
10-year firms	8%	8%	8%	8%	9%	9%	9%	10%	9%	9%
Share of female board directors										
All firms	33.60%	31.00%	31.30%	31.30%	31.10%	31.30%	31.80%	32.20%	32.80%	31.90%
10-year firms	35%	34%	35%	35%	33%	33%	32%	32%	32%	31%
Number of outside board memberships										
All firms	5.6	5.5	4.2	4.1	4	3.8	4.1	3.8	3.4	3
10-year firms	5.5	6.3	5.6	5.4	5.2	4.9	5.1	4.8	4.2	3.6
Share of board members with PhDs										
All firms	7.80%	8.40%	7.80%	7.40%	7.10%	6.60%	5.50%	5.40%	5.70%	5.60%
10-year firms	8%	8%	7%	7%	6%	6%	5%	5%	5%	5%
Observations	208	249	273	272	260	249	239	241	246	239

One further advantage of this dataset is that I observe firms over an extended period of time (up to ten years). During this time period many of the firms have experienced changes in the characteristics relevant to employee representation and board size, i.e., either increased or decreased the number of employees around the different legal threshold levels (see Table 3 and Table 4). This considerable number of companies changing their "codetermination status" allows using fixed-effects regressions to control for unobserved heterogeneity when analyzing this data set.

Table 3: Descriptive statistics on changes in the number of employees, size of supervisory board, and employee representation

Note: Table 3 provides descriptive statistics on changes in the number of employees, size of supervisory board, and employee representation for a sample consisting of all German firms listed in the DAX, MDAX, or SDAX for the years 1998 to 2007. Foreign companies, financial companies and KGaAs were excluded from this analysis. The board size and composition data is obtained from annual reports, data on the number of employees is obtained from Datastream. Number of employees is total number of employees, thus including both domestic and international employees. The number of domestic employees though is the only relevant number for laws requiring a certain size and composition of the board; therefore, I expect more companies with changes to employee representation. Thresholds for size and employee representation are below 500, between 500 and 2,000, and above 2,000 employees.

Type of change	# companies
Change in number of employees from …	
less than 500 to more than 500	24
less than 500 to more than 2,000	1
less than 2,000 to more than 2,000	34
more than 2,000 to less than 2,000	23
more than 2,000 to less than 500	2
more than 500 to less than 500	11
Total	95
Change in size of supervisory board	
Increase in size	56
Decrease in size	47
Total	103
Change in employee representation from …	
no representation to one-third representation	3
one-third representation to no representation	3
no representation to one-half representation	7
one-half representation to no representation	3
one-third representation to one-half representation	9
one-half representation to one-third representation	12
Total	37

Table 4: Companies with changes in the form of codetermination during the years 1998-2007

		Number of years (duration of cluster affiliation)			
Type of change / company	**Total**	**No code-termina-tion**	**1/3 code-termina-tion**	**1/2 code-termina-tion**	**Other form of codetermina-tion**
No codetermination to 1/3 codetermination	3				
DAB BANK AG		1	3		5
GERRY WEBER AG		1	9		
HACH AG		1	2		
1/3 codetermination to no codetermination	3				
ADCAPITAL AG		5	5		
AGIV REAL ESTATE AG		2	1	3	
LOEWE AG		7	2		
No codetermination to 1/2 codetermination	7				
CINEMAXX AG		1		9	
DÜRR AG		3		7	
KAMPS AG		1		4	
MATERNUS KLINIKEN AG		4		6	
MEDICLEAN AG		2		6	
SCHLOTT AG		2		8	
WCM BETEIL.U.GRUNDBESITZ AG		3		7	
1/2 codetermination to no codetermination	3				
CURANUM AG		1	1	4	4
VARTA AG		5		5	
W.E.T. AUTOMOTIVE SYSTEMS AG		5		5	
1/3 codetermination to 1/2 codetermination	9				
D+S EUROPE AG			6	2	
EDSCHA AG			4	1	
GRAMMER AG			2	8	
HUGO BOSS AG			7	3	
MÜNCHENER RÜCKVERSICHER-UNGS-GES. AG			1	9	
SARTORIUS AG			4	6	
STO AG			4	6	
VOGT ELECTRONIC AG			5	5	
VOSSLOH AG			4	5	
1/2 codetermination to 1/3 codetermination	12				
AGIV REAL ESTATE AG		2	1	3	
CURANUM AG		1	1	4	4
DEUTSCHE STEINZEUG AG			2	8	
DYCKERHOFF AG			2	8	
ELEXIS AG			6	3	
HERLITZ AG			1	8	1
HOLSTEN BRAUEREI AG			1	7	
IVG AG			2	8	
MOEBEL WALTHER AG			1	9	
TA TRIUMPH-ADLER AG			3	7	
VOGT ELECTRONIC AG			5	5	
VOSSLOH AG			6	4	

4.3. Conclusion

This unique data set on the composition of German supervisory board allows to advance research on corporate governance in many fields. Research based on this data set (e.g., sections 5,6 and 7 of this thesis as well as Bermig & Frick (2011a), Bermig & Frick 2011b), Balsmeier et al. (2011)) have shown interesting results. Further additions to the data set create even more potential to detail the current research on German corporate governance. Enhancing the data by managing board member data or even further detailing the information on supervisory board members (e.g., age, education) would provide an even larger ground for further research.

5. Board Size, Board Composition and Firm Performance: Empirical Evidence from Germany

5.1. Introduction

In this paper we analyze the effect of board size and board composition on the valuation and performance of German companies during the period 1998-2007. Our main result is that no consistent effect can be demonstrated. Moreover, the results are rather sensitive to the model specification used. Overall, we argue that due to the sensitivity of our results, recommendations relying on previous empirical research on the influence of board size and composition are premature at best. Thus, more empirical work is urgently required to inform and guide the political debate.

The influence of board size and board composition on firm valuation and performance has been an issue in the financial as well as the organizational economics literature (for a recent review see Adams, et al. (2010)). Most of the research has focused on the optimal size and structure of corporate boards in the US market as a value-creating mechanism because a board structure approaching the optimum is assumed to reduce agency costs caused by the separation of ownership and control (i.e., Shleifer & Vishny (1997)). Research from Germany has so far mainly focused on two aspects of board composition: First, on employee representation and, second, on the role of bank representatives in supervisory boards (for a review see Frick & Lehmann (2005)).

Employee representation on corporate boards, also known as codetermination, has been discussed for quite some time (Jensen & Meckling (1979)), but only a few empirical studies exist that examine this issue (see e.g., Baums & Frick (1998); Fauver & Fuerst (2006); Gorton & Schmid (2004)). Most of these empirical studies are either based on small samples with a limited number of observations or on cross-sectional data that does not allow to control for unobserved firm effects[8]. In addition, none of these studies examine the impact of codetermined boards on operational performance and the market valuation of the same panel of firms. It is, therefore, not at all surprising that the available evidence remains ambiguous at best.

8 As criticized by FitzRoy and Kraft (2005).

The role of bank representatives on German boards has also been an area of continuing debate in the finance and organization literature. Early studies discussed possible advantages of the German bank-based system over the Anglo-Saxon market-based financial system. Banks were considered to have a longer term view on investment and, at the same time, to provide financial market expertise and better corporate governance (see e.g., Mayer (1988)). The more recent literature, in turn, studied in more detail the role of banks in corporate governance (Gorton & Schmid (2000)), especially in the aftermath of recent initiatives of the German government to dissolve the "Deutschland AG" (i.e., to reduce equity cross-holdings, especially of bank and insurance companies in non-financial firms, as documented by Dittmann et al. (2010)).

In contrast to these two topics, related areas such as board size or the role of former managing board members have received little attention in research. However, since the enactment of the German Corporate Governance Codex in 2002 and the introduction of the European stock corporation (Societas Europaea) in 2004, these topics have become part of a heated political debate as well.

The purpose of our paper is twofold: We first want to make a methodologically convincing contribution to a body of literature that suffers from a number of shortcomings. We analyze a large and comprehensive dataset including some 300 listed German companies over a period of ten years (1998-2007) to provide a better and more thorough basis for discussion. Second, we try to contribute to the recent political debate on whether the size and the composition of company boards can reduce agency costs by improving the boards' efficiency, thereby improving the companies' operating performance as well as their market valuation.

The German system of corporate governance differs fundamentally from its Anglo-American counterpart: while the latter system has as its main goal the maximization of the returns to the firm's shareholders and thus to mitigate agency problems (Shleifer & Vishny (1997)), the German system also tries to take into account the views of the remaining stakeholders and to include their different views in corporate decision making processes (Fauver & Fuerst (2006)). More specifically, a publicly held German company (*Aktiengesellschaft*) is characterized by a two-tier board structure, consisting of the management board (*Vorstand*) and the supervisory board (*Aufsichtrat*). The management board consists of the executive di-

rectors and is responsible for running the firm on a day-to-day basis and developing its strategy. The supervisory board has, to a large extent, similar duties as the US board of directors as it is responsible for the remuneration of the management board and the appointment of its members. However, the fundamental difference is that the management board reports to the supervisory board and no management board member can at the same time be a member of the supervisory board. We agree nevertheless with Fauver & Fuerst (2006) who argue that the duties and responsibilities of German and American and British supervisory boards are quite similar. However, whether the conclusions that have been derived from research conducted in the Anglo-Saxon world can be transferred to other countries or legal environments remains to be seen.

The rest of the paper is structured as follows: Section 5.2 provides a brief survey of the existing literature. Section 5.3 describes the legal environment in Germany and section 5.4 the dataset we use in our analyses. Section 5.5 summarizes the methodology and section 5.6 reports our empirical findings. Finally, section 5.7 concludes.

5.2. Board Size, Board Composition and Employee Representation: A Review of the Literature

While a lot of research on the impact of board size and board composition on firm performance has been published in the US, the German literature has – as mentioned above – so far focused on two "idiosyncrasies" that are characteristic for its financial and industrial relations system: First, employee representation ("codetermination") and, second, bank representation on supervisory boards. In the following section we provide a brief review of the most recent research on the effectiveness of supervisory boards that differ in size and composition and then proceed with a summary of the available research on codetermination in general and at the supervisory board level in particular as well as on bank representation on German boards.

5.2.1. Board Size, Board Composition, and Board Effectiveness

Previous studies on group decision-making show that it is generally more difficult for larger groups to reach an agreement (e.g., Kogan & Wallach (1966)). Thus, final decisions of larger groups usually require more compromises and, therefore, tend to be less extreme than those made by smaller groups (Kogan & Wallach (1966); Moscovici & Zavalloni (1969)).

Furthermore, with respect to supervisory boards we assume that smaller boards are more effective at monitoring top managers due to lower co-ordination costs and are, therefore, better able to generate a superior firm performance. This is indeed confirmed by various studies examining boards in US companies (e.g., Eisenberg, et al. (1998); Yermack (1996))[9]. However, this view has recently been challenged by other researchers (e.g., Coles et al. (2008) and Dalton et al. (1999)) who argue that larger boards may improve the performance of firms requiring more advice (e.g., particularly complex firms that operate in multiple segments). Raheja (2005) therefore argues that "optimal board size and composition are functions of the directors' and the firm's characteristics".

Apart from its size, the composition of the board should also be considered when analyzing these advice requirements. Due to the clear-cut distinction between outside and inside directors in the “one-tier systems” that is characteristic for most Anglo-Saxon countries, research has so far focused on board structure and board composition as potential determinants of firm performance. Assuming that independent (i.e., outside) directors are better able and have more incentives to monitor and supervise the firm’s top executives, the percentage of the firm’s outside directors is one of the “traditional” measures of board composition. As Hermalin & Weisbach (2003) demonstrate in their survey of the literature, no statistically significant impact of a firm’s number and/or percentage of outside directors on firm performance (be it accounting measures, share prices or firm valuation) has yet been found. Although new rules and regulations passed in the year 2002 require companies that are listed at US stock exchanges to have a majority of independent directors, the major weakness of the available research on the impact of “independent” directors on firm performance has been and continues to be that the degree of independence is unobservable and that the choice of directors is endogenous (Hermalin & Weisbach (2003)). In their survey of the most recent research, Coles et al. (2008) confirm the persistence of these problems and again fail to find a statistically significant influence of board composition on firm performance. This is once more consistent with Raheja (2005) who argues that "the optimal board structure is determined by the trade-off between maximizing the incentive for insiders to reveal their private information, minimizing coordination costs among outsiders and maximizing the ability of outsiders to reject inferior projects".

9 Kini et al. (1995) demonstrate that board size is usually reduced following a takeover.

The "missing link" between board size, board composition, and firm performance may be board effectiveness. While most of the research on board effectiveness in the US reports mixed findings (e.g., Bange & Mazzeo (2004); Kaplan (1994); Morck, et al. (1989)) shows that German supervisory boards are effective in the sense that they quickly replace executives when firm performance has been poor or started to deteriorate.

5.2.2. Employee Representation on Corporate Boards

5.2.2.1. Conflicting Theoretical Positions

Since the early 1950s the size and the composition of German supervisory boards is to a large extent regulated by law (see section 5.3). Not surprisingly, this regulation has always been and remains to be a highly controversial issue. Two broad arguments have been directed against laws that mandate the participation of employee or union representatives in the decision-making of corporate boards. One argument rests on political economy considerations, the other on the logic of profit maximization. The political economy argument for rejecting legal intervention has been summarized by Furubotn (1988: 178) as follows:

> "Efforts by governments to … reshape the firm have not led to particularly desirable results. The approach taken has emphasized the "political" aspect of the firm and the importance of corporate governance while failing to give much attention to broader economic issues and to the relation between the firm's total property-rights structure and its performance. By granting workers major control rights without regard to their actual investment position in the firm, state programs have violated an important rule for ensuring rational allocation – namely, the rule that those making decisions should bear the full costs of the decisions they make. This defect, together with the costly system used to apportion the firm's quasi rents between workers and stockholders, means that the orthodox co-determined firm does not possess a truly efficient organizational structure".

The market-oriented case against mandated codetermination is nicely summarized in the following quote from Jensen and Meckling's seminal paper (1979: 474):

> „If codetermination is beneficial to both stockholders and labor, why do we need laws which force firms to engage in it? Surely, they would do so voluntarily. The fact that stockholders must be forced by law to accept codetermination is the best evidence we have that they are adversely affected by it".

However, there are equally plausible arguments that even though mandated codetermination may be able to provide gains to both workers and firms, it could still be underprovided by the market. If, for example, workers invest in the acquisition of firm-specific human capi-

tal (i.e., if they engage in "durable reliance investments") the firm's profits are likely to increase. In a world of informational asymmetries, however, the firm may be unable to check on the extent to which workers are making that kind of an investment. Moreover, workers may be reluctant to invest in firm-specific skills for an obvious reason:

> „Workers who undertake durable reliance investments commit themselves to the firm for some time into the future and are, therefore, vulnerable. The distribution of the firm's quasi-rents and the value of the labor assets can be affected by the behavior of other members of the coalition. Hence, the possibility exists that worker-investors, if unprotected by institutional or contractual safeguards, may be exploited and suffer serious economic injury" (Furubotn 1988: 167).

This view has been further developed by Levine & Tyson (1990) who argue that worker participation will be underprovided by the market if firms find themselves in a prisoner's dilemma: All firms would benefit if they introduced worker participation, but codetermined firms require – among other things – a compressed wage structure to encourage "group cohesiveness" and dismissal protection to increase workers' time horizon. Traditional firms, on the other hand, motivate their employees through the fear of dismissal and a sharply differentiated wage structure. It is unlikely that under these circumstances a participative equilibrium will emerge: The viability of a single codetermined firm will be threatened by adverse selection (it will attract the less motivated job-seekers) and an externality (its best workers will be poached away by traditional firms). Hence, the market will be systematically biased against codetermined firms and the economy will be locked in a socially suboptimal position. Mandated codetermination has the potential to overcome this dilemma by requiring all firms (above a certain size threshold) to introduce participatory machinery.

> "In distributional conflicts about contractually unprotected quasi-rents, it is at least optimistic, if not naive, to expect an efficient voluntary agreement about the firm's constitution. A selfish rational agent will prefer a constitution that strengthens his absolute position in ex post bargaining, even if this is detrimental to the firm value. One cannot then expect an efficient constitution of the corporation as a result of a bargaining process between co-specialised investors" (Sadowski, et al. (1999)).

Summarizing, theory offers no definitive guidance as to the likely effects of mandated codetermination, i.e., worker representation on corporate boards. The beneficial and the detrimental effects of codetermination must therefore be demonstrated empirically. Before turning to our empirical investigation (sections 5.4-5.6 below) we first provide a brief summary of

the existing literature (sections 5.2.2.2. and 5.2.3.) and a description of the institutional set-up (section 5.3).

5.2.2.2. Employee Representation on Corporate Boards: The Evidence

Given the highly controversial discussion it is certainly surprising that so far only a limited number of studies have been published that analyze the impact of employee representatives on corporate boards on company performance. The majority of the available studies have major shortcomings, such as the use of cross-sectional data that does not allow to control for firm-specific effects (see FitzRoy & Kraft (2005)). This section provides an review of the recent literature on codetermination and employee representation at the board level (see also Table 5; a comprehensive survey of the earlier literature can also be found in Baums & Frick (1998), who argue that the results of most studies are "controversial and inconclusive").

Table 5: Summary of current research on the impact of employee representation (codetermination) on firm performance in Germany

Author(s)/Year	Sample/data	Approach/Method used	Results
Baums and Frick (1998)	28 firms subject to codetermination court decisions in Germany, 1974-1995	Event study methodology to evaluate impact of court decisions about employee representation in the supervisory board on stock prices	No financial losses to shareholders due to judicial decisions extending codetermination
Schmid and Seger (1998)	160 observations of German firms for the years 1976, 1987, and 1991 (number of firms not available, 1991 sample contains 63)	Regression of market-to-book ratios on codetermination dummy	Equity of firms subjet to parity-codetermination valued on average 18% below firms subject to 1/3 codetermination
Gorton and Schmid (2000)	Sample 1: 82 German firms in 1975, 56 in 1986	OLS-regression to determine the effect of codetermination on market-to-book ratios and return on equity	Sample 1: Parity-codetermination has no significant impact on market valuation, but a negative impact on ROE by 3.25 basis points
	Sample 2: 283 German firms in 1975, 280 in 1986		Sample 2: Parity-codetermination reduces market-to-book ratio by 15.9%, but has no significant effect on ROE
Gorton and Schmid (2004)	250 largest listed companies in Germany, 1989-1993 (n=149-161 observations/year)	OLS-regression to evaluate impact of parity-codetermination on firm valuation (market-to-book ratio)	Parity-codetermination has a significant negative impact on valuation - valuation is on average 31% lower than 1/3 codetermination firms
Kraft and Stank (2004)	155 German corporations, 1971-1990	Difference-in-differences estimation of effect of codetermination on the number of patents granted	Positive effect of codetermination of the number of patents granted to the company
Werner and Zimmermann (2005)	232 observations from the largest German companies (listed in either DAX30, MDAX, SDAX, or TecDAX, number of firms not available), 2002 and 2003	Regressions on the change of the number of employees to research the impact of union representatives on the corporate board	Presence of union representatives on the board has a significant negative impact on the growth of the number of employees

Table 5 (continued)

Author(s)/Year	Sample/data	Approach/Method used	Results
FitzRoy and Kraft (2005)	179 firms in 2 unbalanced panels for the periods 1972-1976 and 1981-1985	Estimation of Cobb-Douglas production functions with sales as dependent variable (estimation with difference-in-differences approach as suggested by Hausman-Taylor)	While all forms of codetermination have a positive impact on sales growth, firms with parity-codetermination show the highest growth
Vitols (2006)	500 listed German firms, 2000-2004	Fixed-effects regression of employee clusters on return on equity and market-to-book ratio	No negative effect of codetermination on either return of equity or market-to-book ratio, parity-codetermined firms show higher market-to-book ratios as 1/3 codetermined firms
Gerum and Debus (2006)	226 codetermined firms for the year 2004	OLS-regression to evaluate the determinants of a larger than required supervisory board	In 25% of the firms the supervisory board is larger as required by law, also increasing codetermination - the effect is the same for public and private companies
Fauver and Fuerst (2006)	786 German firms for the year 2002	Estimatimation of effect of codetermination on market valuation (measured by Tobin's Q) using OLS regressions (also checking results with logit and instrumental variable approach)	Positive effect of employee representation on firm efficiency and market value - optimal level of representation likely below 50% (inversed U-shaped relation between firm value and employee representation)

Table 5 (continued)

Author(s)/Year	Sample/data	Approach/Method used	Results
Fauver and Fuerst (2006)	786 German firms for the year 2002	Estimatimation of effect of codetermination on market valuation (measured by Tobin's Q) using OLS regressions (also checking results with logit and instrumental variable approach)	Positive effect of employee representation on firm efficiency and market value - optimal level of representation likely below 50% (inversed U-shaped relation between firm value and employee representation)
Renaud (2007)	Data from German corporations with either 1/3 oder parity-codetermination, 1970-2000, n=12,185, number of firms not available	Estimation of translog-proudcution function using OLS regressions to compare long-termin differences in productivity and profitability for parity- and 1/3 codetermined firms	Firms switching from 1/3 to parity-codetermination show increases in both productivity and profitability, while long-term productivity does not seem to be affected, profitability also increases with parity-codetermination
Strom (2007)	All non-financial firms listed on the Oslo Stock Exchange (OSE), 1989-2002, n=1135	Estimation of relationship between employee representation and other corporate governance measures on market valuation (measured by Tobin's Q) using simultaneous equations regressions	Negative empact of employee directors on the board on firm performance
Vulcheva (2008)	672 German companies, 1998-2006, n=3,251	Estimation of effect of various forms of codetermination on earnings managements using OLS regressions	Negative relationship between employee board representation and earnings management

More recent research about codetermination in Germany yields the same mixed results: Based on an event study (n=28 court decisions) Baums & Frick (1998) report that the expansion of codetermination does not lead to financial losses for shareholders. Schmid & Seger (1998), however, find a negative impact of codetermination (n=160 firms). According to their estimates firms with codetermined boards (i.e., those with half of the members being employee representatives) are valued 18% less than firms with one-third codetermination. Similar effects are found by Gorton & Schmid (2000) who examine two samples of companies before 1975 and after 1986 the introduction of the codetermination law in 1976 (*Mitbestimmungsgesetz*). Here the market-to-book ratio turns out to be almost 16% lower in codetermined firms than in one-third codetermined ones. In a further empirical study Gorton & Schmid (2004) find even stronger negative results of codetermination: Using a dataset that includes the 250 largest listed German companies over the period 1989-1993 they estimate that the value of codetermined firms is – on average – 31% lower than that of firms that are subject to one-third codetermination only. On the other hand, FitzRoy & Kraft (2005) find a significantly positive and economically relevant effect of codetermination on sales growth (their sample includes 179 German firms over the years 1972-1976 and 1981-1985). Using a sample of 500 listed German companies in the years 2000-2004, Vitols (2006) finds that codetermination neither has a significant effect on market valuation nor on return on equity. More surprising – and contrary to Schmid & Seger (1998) as well as Gorton & Schmid (2000, 2004) – he finds that codetermined firms have significantly higher market valuations than firms that are subject to one-third codetermination. Similar results are reported by Fauver & Fuerst (2006). Based on a large dataset including 786 German firms in the year 2002, they find that, first, codetermination has a positive effect on market valuation and, second, that the optimal level of codetermination is below 50%. Finally, Renaud (2007) shows that an increase of codetermination from one-third to parity has a positive impact on productivity as well as on profitability (his sample is particularly large with n > 12,000 firm-year-observations).

The two most recent studies of German codetermination once more produce inconsistent results: Vulcheva (2008) shows that the probability as well as the magnitude of earnings management is lower for firms with employee representatives on their boards (her sample includes 672 firms in the years 1998-2006 with 3,251 firm-year-observations). Petry (2009), in turn, demonstrates a negative impact of codetermination in his event study that uses

a sample of 140 firms before and after 1976. He finds that share prices of companies that were affected by the *Mitbestimmungsgesetz* of 1976 experienced negative returns. Moreover, using another sample with 90 firms in the years 1998-2008, he finds negative announcement effects for firms that increased the number of employee representatives on their boards and finds positive announcement effects for companies that reduced that number. Summarizing the available evidence, it appears that a clear picture of the economic effect of codetermination on company performance and market valuation is still lacking.[10]

5.2.3. Bank Representatives on Corporate Boards

The German banking system with its strong linkages between financial and non-financial companies has been discussed extensively in the literature. This strong linkage is mainly due to the fact that banks take numerous roles in their relationship with non-financial firms: First, they act in their "typical" role as lenders, second, they are often equity owners of non-financial companies, and third, they exercise proxy votes from shares deposited at the banks by their customers. Due to their role as equity owners, banks usually place their own representatives on the supervisory boards of listed companies. In their role as equity owners and lenders, bank representatives are often considered as better monitors due to their privileged access to information. Consistent with this argument, Gorton & Schmid (2000), Edwards & Nibler (2000) as well as Lehmann & Weigand (2000) find that bank ownership and bank representation on the supervisory board positively affect firm performance. More recent research, however, yields different results: Dittmann et al. (2010) do not find any evidence that bankers are better monitors but show that bank representatives have a negative impact on valuation. One explanation for these incompatible findings is the changes in the institutional landscape in Germany. Due to a change in capital gains taxation in 2002, the average equity-ownership of banks in non-financial companies declined from 4.1% in 1994 to 0.4% in 2005 (Dittmann et al. (2010)). This also caused a decline in the number of board seats held by bank representatives from 9.6% to 5.6% between 1994-2005 as well as in the number of boards with bank representatives (from a high 51% to a low 33%) ((Dittmann et al. (2010)). The dataset we use to estimate the models presented below corroborates these results: First, the per-

10 A rather interesting fact, which we will not discuss in more detail, is found by Boneberg (2009) and Troch (2009): only half of the German manufacturing and service companies with limited liability (GmbH) with employees from 500 to 2,000 actually do have a supervisory board.

centage of boards with bank representatives in all non-financial companies[11] declined from 54% in 1997 to 34% in 2007 and, second, the average number of board seats held by bankers decreased too (from 7.9% in 1997 to 4.5% in 2007).

5.3. Legal Framework

Generally, the law for stock corporations (*Aktiengesetz*) stipulates a minimum number of 3 and a maximum of 21 seats on corporate boards depending on statutory equity capital. Furthermore, a set of different codetermination laws determines the size and the composition of the supervisory board of all private limited liability corporations (GmbH) and publicly listed companies (Aktiengesellschaft)[12]: The *Montanmitbestimmungsgesetz* of 1951 requires that companies with more than 1,000 employees operating in the steel, mining and coal sector are subject to a 50% employee and 50% shareholder representation on the supervisory board (usually called "one-half" and/or "parity" codetermination). Depending on the statutory equity capital of the company and the number of its employees, the size of the board is set to either 11, 15 or 21, always including one "neutral" member, i.e., a member that is neither a representative of the employees nor of the shareholders. For boards with 15 and 21 members, two or three union members are part of the employees' representatives. In 1976, the *Montanmitbestimmungsgesetz* was extended to companies in other industries. The new law ("*Mitbestimmungsgesetz")* stipulates that in public companies with more than 2,000 domestic employees half of their board seats have to be filled by employee representatives. The chairperson of the board has two votes in a tied situation and remains a shareholder representative. Thus, this form of codetermination is called "quasi-parity" codetermination. To simplify the discussion, we will refer to this form of codetermination also as "parity" or "one-half" codetermination as research has demonstrated that most decisions are made in unison and that the chairperson rarely uses his/her second vote to outvote the employee representatives (Kommission Mitbestimmung (1998)). Depending on the number of employees the size of the board is either 12, 16, or 20 for companies with domestic employment ranging from 2,000 to less than 10,000, 10,000 to less than 20,000 and more than 20,000 respectively. Moreover, depending on the size of the board, two or three seats are reserved for union representatives, i.e., the seats must not be given exclusively to members of the works council. One of the employee representa-

11 All companies except those with SIC industry group 6 (banks, insurance and real-estate companies); on average 199 observations per year; only domestic companies were considered.

12 All companies which primary business is in the field of media or religious, union or political activities are not subject to these codetermination laws.

tives must also be a member of "middle management" (*leitender Angestellter*). Finally, all public companies (with the exception of those that are family-owned), which employ between 500 and 2,000 persons, are subject to the *Drittelbeteiligungsgesetz* of 2004, requiring these companies to have at least one-third of their board seats filled with employee representatives.

5.4. Sample Composition and Data Sources

Our data includes all publicly listed German companies that were listed for at least one year in one of the three main German indices - DAX, MDAX, or SDAX which are constituted of the German public companies with the largest market capitalization – during the period 1998-2007. Furthermore, only those companies with at least two years of available data were included in the database. As we were not able to obtain annual reports for one or more years for seven companies, the initial sample consists of 2,476 observations from 306 companies. From this initial sample we drop all companies that are incorporated as *Kommanditgesellschaft auf Aktien* (KGaA), as this is a hybrid organizational form between a partnership and a stock corporation, and all foreign companies as these are not subject to German law. This leaves us with 2,382 observations from 294 firms in our final dataset.

All data on supervisory board composition was hand-collected from annual reports. Reports not available from the company's website were obtained from the annual report database of the *Schutzgemeinschaft der Kapitalanleger e.V.* as well as various archives in Germany (Archive of the Bavarian Chambers of Commerce, Archive of the University of Bremen, Archive of the University of Cologne). Finally, if no reports were available, data for supervisory board composition was assembled using the *Hoppenstedt Jahrbuch der Großunternehmen*. Measures of accounting performance as well as business and geographic segment data were obtained from Thomson Reuters Worldscope. Accounting data that was missing in Worldscope was taken from the companies' annual reports. The data on market capitalization comes from Datastream. Finally, we added information on specific company events (restructurings, mergers & acquisitions) following an extensive press search.

5.5. Methodology

In this section we present and discuss the variables used in our estimations as well as the econometric model.

5.5.1. Variables

Our analysis comprises a series of fixed effects regressions using different measures of market valuation and firm performance to identify the impact of board size and board composition. To ensure the robustness of our results we use different measures of performance, which we assume to be complements rather than substitutes.

As dependent variables and our preferred measures of capital market performance we use Tobin's Q[13] (*Tobin_Q*) and total shareholder return (*tot_ret_ind*; total return including capital gains as well as possible dividend payments[14]) in our estimations; consistent with previous studies (e.g., Cheng (2008); Coles, et al. (2008); Eisenberg, et al. (1998)) we use Tobin's Q to measure corporate value, total shareholder return to measure stock performance and return on equity[15] (*ROE*) and return on invested capital[16] (*ROIC*) to measure accounting performance. The low correlation between Tobin's Q, total share return and our accounting measures show that they measure different aspects of corporate performance (see table 13).

As independent variables we use first of all board size (*size*) which is the absolute number of members of the supervisory board at the end of the financial year (as documented in the annual report). As discussed in section 5.2.1 we expect a negative effect of board size on valuation and performance (as demonstrated by e.g., Yermack (1996)). For boards of particularly complex firms, however, we expect a positive relationship between board size and valuation as well as performance. Most previous studies using data from Germany do not take board size into consideration as it is largely determined by law (see section 5.3 above). However, companies seem to have quite some discretion and flexibility with regard to the size of the

13 Calculated as follows: $$Tobin'sQ = \frac{Market\ value\ of\ equity + Book\ value\ of\ assets - Book\ value\ of\ equity}{Book\ value\ of\ assets}$$

14 Total return to shareholders equals total return index on Worldscope. For easier interpretation of our results we re-based the index to 100 in the first year of observation

15 Calculated as follows: Return on equity - (Net Income before Preferred Dividends - Preferred Dividend Requirement) / Last Year's Common Equity * 100.

16 Calculated as follows: (Net Income before Preferred Dividends + ((Interest Expense on Debt - Interest Capitalized) * (1-Tax Rate))) / Average of Last Year's and Current Year's (Total Capital + Last Year's Short Term Debt & Current Portion of Long Term Debt).

board. Gerum & Debus (2006) for example find that 25% of listed German companies have larger supervisory boards than required. We make the same observation in our dataset: In every single year of our observation period, between 24% and 28% of the boards are larger than required[17] (with an average of 4.0 to 4.8 additional board members).

As measures of board composition we first discuss the variables indicating the level and the degree of codetermination: *Union_Rep* indicates the percentage of total board seats held by union representatives, *Woco_Rep* the share of works council representatives and, finally, *Ind_Rep* the respective percentage of independent employee representatives[18]. As the sum of these measures for codetermination indicates the type of codetermination (e.g., if the sum equals to 0.5 the company is parity-codetermined), we did not include a further measure for codetermination type[19]. With regard to the effects of codetermination on company performance, two predictions are equally plausible: On one hand, codetermination may have a positive influence on valuation and performance because of the pronounced incentives of employee representatives to monitor management (as mentioned in section 5.2.2.). On the other, mandated codetermination may have a negative effect since it invites rent-seeking activities of employee representatives. Thus, we are unable to predict the likely outcome and have to leave it to the estimations.

To measure the influence of bank representatives who are supervisory board members on company performance we use in our estimations the percentage of the seats filled by bankers (*Bank_Rep*)[20]. Since this available evidence is rather mixed (see section 5.2.3) we refrain from predicting the sign of the coefficient. As our final measure of board composition we use the percentage of former management board members (*Former_BM*). As in the case of employee representatives, their impact on capital market valuation as well as operating performance can be either positive or a negative. Specifically, a positive impact is to be expected if

17 We calculated the required size based upon total employees, which include domestic and international employees; domestic employees only though are used to determine the size base on the legal requirements; thus, we expect this number to be lower than the actual value.

18 Independent representatives are those who are not classified as either union representatives or works council representatives in the respective annual reports.

19 We included measures for type of codetermination (one halt and one third codetermination) as additional variables – the results were very similar to our results described below without these measures; only the measure for one-half codetermination showed a significant (at 5% level) positive effect, further differences were only observed with the share of works council representatives which show a negative effect (significant at the 5% level). These results are available from the authors upon request.

20 We call bank representatives all board members who are declared as employee of a bank or have "Banker" as their job title in the annual report.

former board members use their insider knowledge to act as diligent monitors and knowledgeable advisors. Conversely, if former top managers are primarily interested in hiding mistakes they have made in the past, they may neglect their duties as monitors and advisors. In the latter case we expect a negative influence of the percentage of former board members on valuation and performance.

Assuming that monitoring skills increase with experience we control for the specific human capital of board members using a count variable measuring all outside supervisory board memberships the individual members of a particular supervisory board hold in the respective year in other DAX-, MDAX- and SDAX-companies (*exp_datab*).

Company size is measured by the natural logarithm of total assets (*log_ass*) and by total sales (*sales*). *Leverage* measures the firm's capital structure (short term and long term debt divided by total assets) to control for the disciplining effect of debt (see Jensen (1986)). To control for growth opportunities as well as for profitability we use the share of capital expenditures to sales (*Capex_Sales*) and the operating margin (*Operating_Margin*). As numerous previous studies for the German market have repeatedly shown, companies with a more concentrated ownership structure are valued more highly (see e.g., Gorton and Schmid (2000)). Therefore, we control for "blockholding" using three different dummy variables (*block_25*, *block_50*, and *block_75*). If total ownership of blockholders (i.e., shareholders with at least 5% of the total shares) exceeds 25%, the variable *block_25* assumes the value of one (zero otherwise). *Block_50* (*block_75*) assumes the value one if total blockholder ownership exceeds 50% (75%) and zero otherwise. The structure of these ownership variables is similar to the one used by Franks and Mayer (2001) who argue that these three levels of ownership are important thresholds in Germany: ownership in excess of 25% creates a blocking minority which can be used, for example, to avoid issuing new shares or to dismiss supervisory board members. If ownership is more than 50%, it allows complete control of management, and with more than 75% no other blocking minority is possible.

Since Fauver & Fuerst (2006) document a significant diversification discount for German companies (for both, business segment and geographic diversification), we use the same measures (which have also been used in an earlier study on diversification discounts around the world by Lins & Servaes (1999)): the dummy variable *ind_divers* assumes the value of

one if less than 90% of a company's sales can be attributed to a single four-digit SIC segment. To measure geographic diversification we use the dummy variable *geo_divers*, which assumes the value of one if less than 90% of a company's sales can be attributed to one geographic segment as defined by Worldscope. We control for industry concentration and competition with a sales-based Herfindahl-index (*herfindahl*) measuring the degree and the intensity of competition in the main industry segment of the companies[21].

Finally, we control for the occurrence of exceptional events with two additional dummy variables: *Restruct* assumes the value one if the company is in a phase of restructuring while *m_and_a* assumes the value one if the company has been taken over in the year of interest. In addition to the control variables discussed above we also enter in our estimations industry dummies based on two-digit SIC codes to control for industry-specific effects and year dummies to control for any changes over time. Table 6 provides a description of the main variables used, table 7 provides descriptive statistics of our dependent and independent variables. Extremely small values are caused by holding companies, companies that have just been founded or even companies that are in financial distress.

21 We calculated this sales-based Herfindahl index using the sales of the all companies, which were available on Worldscope for the respective year. The calculation is based on the main SIC-segment of all companies.

Table 6: Description of main variables

Variable	Name	Definition	n	Source
Dependent variables				
Tobin's Q	tobin_q	(Market capitalization + total assets - shareholder's equity) / total assets	2382	Worldscope/ own calculation
Total return to shareholders	tot_ret_ind	Indexed total return to shareholders (index set to 100 in first year) defined as: total return (t) = total return (t-1) * (price(t) / price (t-1))* (1+dividend yield)*(1/number of working days)	2382	Worldscope/ own calculation
Return on equity	roe	Return on equity - (Net Income before Preferred Dividends - Preferred Dividend Requirement) / Last Year's Common Equity * 100	2382	Worldscope
Return on invested capital	roic	(Net Income before Preferred Dividends + ((Interest Expense on Debt - Interest Capitalized) * (1-Tax Rate))) / Average of Last Year's and Current Year's (Total Capital + Last Year's Short Term Debt & Current Portion of Long Term Debt) * 100	2382	Worldscope
Explanatory variables				
Supervisory board size	size	Size of supervisory board	2382	Annual reports
Share of union representatives	union_rep	Share of union representatives of total board members	2382	Annual reports
Share of works council representatives	woco_rep	Share of works council representatives of total board members	2382	Annual reports
Share of independent employee representatives	ind_rep	Share of independent employee representatives of total board members	2382	Annual reports
Share of bank representatives	bank_rep	Share of bank representatives of total board members	2382	Annual reports
Share of former board members	former_bm	Share of former managing board members of total board members	2382	Annual reports
Supervisory experience	experience	Cumulated number of further supervisory board memberships of all members in listed German companies (DAX, MDAX, SDAX) in respective year	2382	Annual reports
Total assets	log_assets	Logarithm of total assets	2382	Worldscope
Sales	sales	Net sales	2382	Worldscope
Industrial diversification	ind_diversifierd	Dummy variable, equals 1 if max. 90% of total sales are from one SIC-segment	2382	Worldscope/ own calculation
Geographical diversification	geo_diversified	Dummy variable, equals 1 if max. 90% of total sales are from one geographic segment (as defined by Worldscope)	2382	Worldscope/ own calculation
Competitive intensity	herfindahl	Sales-based Herfindahl-index based on 2-digit SIC industry-codes	2382	Worldscope/ own calculation

Table 2 (continued)

Variable	Name	Definition	n	Source
Explanatory variables (cont'd)				
Blockholders with >25% holdings	block_25	Dummy variable, equals 1 if the cumulated share of blockholders (shareholders with >5% holdings) is larger than 25%	2382	Worldscope
Blockholders with >50% holdings	block_50	Dummy variable, equals 1 if the cumulated share of blockholders (shareholders with >5% holdings) is larger than 50%	2382	Worldscope
Blockholders with >75% holdings	block_75	Dummy variable, equals 1 if the cumulated share of blockholders (shareholders with >5% holdings) is larger than 75%	2382	Worldscope
Financial leverage	leverage	(Short term debt + long term debt) / total assets	2382	Worldscope/ own calculation
Investments/capital expenditures	capex_sales	Capital expenditures divided by net sales	2382	Worldscope
Operating margin	operating_margin	Operating net income divided by net sales	2382	Worldscope
Restructuring	restruct	Dummy variable, equals 1 if the company is in a restructuring phase	2382	Press search
Mergers and acquisitions	m_and_a	Dummy variable, equals 1 if the company is being taken over	2382	Press search

Table 7: Descriptive statistics (without year and industry dummies)[22]

Note: Table 7 provides descriptive statistics for the dependent and main independent variables of our model. The total number of observations for ROIC is slightly reduced due to missing values. Tobin's Q is defined as the market values of equity plus the book value of assets minus the book value of equity divided by the book value of assets, total return index is the total shareholder return (defined as capital gains as well as possible dividends paid; the index is re-based to 100 when the company enters the database), ROE is the return on equity (calculated as net income before preferred dividends minus preferred dividends requirements divided by last year's common equity multiplied by 100), ROIC is the return on invested capital (defined as net income before preferred dividends + ((interest expense on debt - interest capitalized) * (1-tax rate))) divided by average of last year's and current year's (total capital + last year's short term debt and current portion of long term debt). Board size is the size of the board, share of union representatives is the share of union representatives of total board members, share of works council representatives is the share of works councils representatives, and share of independent employee representatives the share of independent employee representatives. Share of bank representatives is the share of bank representatives and share of former managing the share of former managing board members. Further supervisory board experience is the total number of outside board memberships of all members in the respective year. Total assets (log) is the logarithm of total assets, sales is total sales for the respective year, financial leverage is defined as short term and long term debt divided by total assets, capex-to-sales ratio is capital expenditures divided by sales, operating margin is defined as operating income divided by sales. Blockholders >25% equals one when blockholders (defined as shareholders with at least 5% ownership) own at least 25%, blockholders >50% and blockholders >75% are similarly defined. Industrially diversified equals one if the company is industrially diversified (not more than 90% of sales in one four-digit SIC segment) and geographically diversified equals one if the company is geographically diversified (nor more than 90% of sales in one geographic segment as defined by Worldcsope). Industry competitiveness is measured via the herfindahl index, a concentration measure for the main industry in which the company mainly operates; it is calculated based on the two-digit main SIC segment sales using all German companies available on Worldscope for the respective year. The dummy for mergers and ac assumes one if the company if the company is in the process of being taken over, the dummy for restructuring assumes one if the company is in a phase of restructuring. The sample consists of all German companies listed in the DAX, MDAX, and SDAX for the years 1998 to 2007 with at least two years of available data.

22 The 5 extreme values at both ends of the dependent variables as well as of operating margin (i.e., the 5 highest and the 5 lowest values) were reduced/increased to respective 6th value; this was done to reduce the effect of outliers ("winzorizing"). The results of our estimations though remained similar. Appendix table 1 shows which values were reduced/increased and table 2 gives an example of regression results using both winzorized and non-winzorized values.

Variable	Mean	St.-dev.	1. Quartile	Median	3. Quartile	Minimum	Maximum
Tobin's Q	1.52	1.23	1.00	1.16	1.53	0.47	11.54
Total return index	145.44	283.01	58.87	100.00	142.67	0.67	4,153.48
ROE	-1.25	91.02	1.95	9.79	16.40	-1,162.06	482.98
ROIC	6.68	19.56	2.69	7.45	12.58	-189.33	97.94
Board size	9.94	5.94	6.00	9.00	12.00	3.00	21.00
Share of union representatives	0.07	0.08	0.00	0.00	0.15	0.00	0.30
Share of works council representatives	0.09	0.12	0.00	0.00	0.19	0.00	0.35
Share of independent employee representatives	0.15	0.14	0.00	0.08	0.33	0.00	0.50
Share of bank representatives	0.07	0.11	0.00	0.00	0.10	0.00	1.00
Share of former managing board members	0.04	0.08	0.00	0.00	0.05	0.00	0.50
Further supervisory board experience	4.17	6.64	0.00	1.00	4.00	0.00	43.00
Total assets (log)	13.57	2.47	11.82	13.20	14.97	3.83	21.42
Sales	5,947,970	16,500,000	144,051	563,031	2,924,071	0	162,000,000
Financial leverage	0.27	0.21	0.09	0.24	0.40	0.00	1.71
Capex-to-sales ratio	0.10	0.90	0.02	0.04	0.06	-0.66	40.46
Operating margin	2.13	28.28	-0.03	3.81	8.24	-341.15	94.58
Blockholders >25%	0.59	0.49	0.00	1.00	1.00	0.00	1.00
Blockholders >50%	0.37	0.48	0.00	0.00	1.00	0.00	1.00
Blockholders >75%	0.12	0.33	0.00	0.00	0.00	0.00	1.00
Industrially diversified	0.42	0.49	0.00	0.00	1.00	0.00	1.00
Geographically diversified	0.63	0.48	0.00	1.00	1.00	0.00	1.00
Industry competitiveness (Herfindahl)	0.53	7.90	0.14	0.21	0.42	0.04	272.78
Mergers & acquisition dummy	0.02	0.15	0.00	0.00	0.00	0.00	1.00
Restructuring dummy	0.01	0.11	0.00	0.00	0.00	0.00	1.00

5.5.2. Econometric Methodology

To estimate the effect of board size and board composition on capital market valuation and operating performance, we estimate the following general model[23]:

$$
\begin{aligned}
&Tobin\_q_{i,t}(or\ Tot\_ret\_ind_{i,t}\ or\ ROE_{i,t}\ or\ ROIC_{i,t}) = \alpha_0 + \alpha_1 Union\_rep_{i,t} \\
&+ \alpha_2 Woco\_rep_{i,t} + \alpha_3 Ind\_rep_{i,t} + \alpha_4 Bank\_rep_{i,t} + \alpha_5 Former\_BM_{i,t} \\
&+ \alpha_6 Exp\_datab_{i,t} + \alpha_7 \log\_ass_{i,t} + \alpha_8 Sales_{i,t} + \alpha_9 leverage_{i,t} \\
&+ \alpha_{10} Capex\_sales_{i,t} + \alpha_{11} Operating\_margin_{i,t} + \alpha_{12} Block\_25_{i,t} \\
&+ \alpha_{13} Block\_50_{i,t} + \alpha_{14} Block\_75_{i,t} + \alpha_{15} Ind\_divers_{i,t} + \alpha_{16} Geo\_divers_{i,t} \\
&+ \alpha_{17} Herfindhal_{i,t} + \alpha_{18} year\_dummies_{i,t} + \varepsilon_{i,t}
\end{aligned}
\qquad (1)
$$

One of the main advantages of our dataset is that we observe companies over an extended period of time (up to ten years). During this time period many of the companies have experienced changes in the characteristics relevant to employee representation and board size, i.e., either increased or decreased the number of employees around the different legal threshold levels (see Tables 8 and 9). These companies are of particular interest in our context: First, the changes around the legal thresholds show that companies do not actively manage the number

23 To analyze sector specific effects of board size and composition, we extend the model to include a series of interaction terms (for further details see section 5.6.2.).

of employees to completely avoid or to reduce the level of codetermination. Second, the considerable number of companies changing their "codetermination status" allows us to use fixed-effects regressions to control for unobserved heterogeneity. As many authors before us, who used cross-sectional data or longitudinal data covering rather short periods of time, we would not have been able to apply this approach if relevant variables (i.e., employee representation and board size) would have been constant over time. The change of the relevant variables over time is also displayed in Table 10, which shows the overall, between and within variation. While the between variation is in most cases larger, we see considerable within variation as well.

Table 8: Descriptive statistics on changes in the number of employees, size of supervisory board, and employee representation

Note: Table 8 provides descriptive statistics on changes in the number of employees, size of supervisory board, and employee representation for a sample consisting of all German firms listed in the DAX, MDAX, or SDAX for the years 1998 to 2007. The board size and composition data is obtained from annual reports, data on the number of employees is obtained from Datastream. Number of employees is total number of employees, thus including both domestic and international employees. Domestic employees though is the only relevant number for laws requiring a certain size and composition of the board; therefore, we expect more companies with changes to employee representation. Thresholds for size and employee representation are below 500, between 500 and 2,000, and above 2,000 employees.

Type of change	# companies
Change in number of employees from …	
less than 500 to more than 500	24
less than 500 to more than 2,000	1
less than 2,000 to more than 2,000	34
more than 2,000 to less than 2,000	23
more than 2,000 to less than 500	2
more than 500 to less than 500	11
Total	95
Change in size of supervisory board	
Increase in size	56
Decrease in size	47
Total	103
Change in employee representation from …	
no representation to one-third representation	3
one-third representation to no representation	3
no representation to one-half representation	7
one-half representation to no representation	3
one-third representation to one-half representation	9
one-half representation to one-third representation	12
Total	37

Table 9: Companies with changes in the form of codetermination during the years 1998-2007

Type of change / company	Total	Number of years (duration of cluster affiliation)			
		No code-termination	1/3 code-termination	1/2 code-termination	Other form of codetermination
No codetermination to 1/3 codetermination	3				
DAB BANK AG		1	3		5
GERRY WEBER AG		1	9		
HACH AG		1	2		
1/3 codetermination to no codetermination	3				
ADCAPITAL AG		5	5		
AGIV REAL ESTATE AG		2	1	3	
LOEWE AG		7	2		
No codetermination to 1/2 codetermination	7				
CINEMAXX AG		1		9	
DÜRR AG		3		7	
KAMPS AG		1		4	
MATERNUS KLINIKEN AG		4		6	
MEDICLEAN AG		2		6	
SCHLOTT AG		2		8	
WCM BETEIL.U.GRUNDBESITZ AG		3		7	
1/2 codetermination to no codetermination	3				
CURANUM AG		1	1	4	4
VARTA AG		5		5	
W.E.T. AUTOMOTIVE SYSTEMS AG		5		5	
1/3 codetermination to 1/2 codetermination	9				
D+S EUROPE AG			6	2	
EDSCHA AG			4	1	
GRAMMER AG			2	8	
HUGO BOSS AG			7	3	
MÜNCHENER RÜCKVERSICHER-UNGS-GES. AG			1	9	
SARTORIUS AG			4	6	
STO AG			4	6	
VOGT ELECTRONIC AG			5	5	
VOSSLOH AG			4	5	
1/2 codetermination to 1/3 codetermination	12				
AGIV REAL ESTATE AG		2	1	3	
CURANUM AG		1	1	4	4
DEUTSCHE STEINZEUG AG			2	8	
DYCKERHOFF AG			2	8	
ELEXIS AG			6	3	
HERLITZ AG			1	8	1
HOLSTEN BRAUEREI AG			1	7	
IVG AG			2	8	
MOEBEL WALTHER AG			1	9	
TA TRIUMPH-ADLER AG			3	7	
VOGT ELECTRONIC AG			5	5	
VOSSLOH AG			6	4	

Table 10: Overall, between and within variation of main variables

Variable		Mean	Std. Dev.	Min	Max
Tobin's Q	overall	1.5	1.23	0.47	11.54
	between		0.94	0.57	8.08
	within		0.86	-2.54	10.96
Total return index	overall	145.4	283.01	0.67	4153.48
	between		218.51	15.11	2974.00
	within		190.98	-2728.56	2645.74
ROE	overall	-1.3	91.02	-1162.06	482.98
	between		44.87	-393.00	199.34
	within		80.32	-1065.95	483.36
ROIC	overall	6.7	19.56	-189.33	97.94
	between		11.14	-61.76	48.28
	within		16.34	-169.01	128.76
Board size	overall	9.9	5.94	3.00	21.00
	between		5.84	3.00	21.00
	within		1.25	0.34	16.34
union_rep	overall	0.1	0.08	0.00	0.30
	between		0.07	0.00	0.24
	within		0.02	-0.11	0.20
woco_rep	overall	0.1	0.12	0.00	0.35
	between		0.12	0.00	0.35
	within		0.03	-0.15	0.31
ind_rep	overall	0.1	0.14	0.00	0.50
	between		0.14	0.00	0.43
	within		0.04	-0.25	0.41
bank_rep	overall	0.1	0.11	0.00	1.00
	between		0.10	0.00	0.67
	within		0.06	-0.35	0.65
former_bm	overall	0.0	0.08	0.00	0.50
	between		0.07	0.00	0.33
	within		0.04	-0.23	0.34
experience	overall	4.2	6.64	0.00	43.00
	between		6.44	0.00	40.50
	within		2.20	-10.83	20.17

5.6. Results

5.6.1. Descriptive Results

Table 11 and Table 12 provide a detailed description not only of the size structure, but also the composition of supervisory boards in German companies. Since we are the first to distinguish between the three different types of employee representatives (works council, union, and independent representatives), we first take a closer look at the respective shares. In our sample, about 65% of the firm-year-observations have boards with independent employee representatives (mean board size is 12.8 members). About 40% of our observations are firm years with works council representatives (these boards are somewhat larger with 13.9 members). Finally, 46% of our firm-year-observations are for boards that have union representatives on them. These latter boards are by far the largest (with 15.3 members).

Banks are represented on 43% of the supervisory boards (with an average board size of 12.2). Moreover, about 29% of all supervisory boards have former managing board members on them (the average size is again 12.2). As expected, companies with larger boards have a higher percentage of employee and bank representatives as well as former managing board members.

Table 11: Characteristics of German supervisory board size and supervisory board composition

Note: This includes boards of all German listed companies, except foreign companies, KGaAs and financial services firms. (as part of a union or representative of the executive employees).

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Entire sample
Board size	10.8	10.2	9.8	9.9	10.1	9.8	9.9	9.8	9.7	9.6	9.9
Employee representatives	4.6	4.2	3.9	4.0	4.1	3.9	4.0	3.9	3.8	3.8	4.0
Union representatives	1.2	1.1	1.0	1.0	1.1	1.0	1.0	1.0	1.0	1.0	1.0
Works council representatives	1.4	1.3	1.2	1.2	1.2	1.3	1.3	1.3	1.2	1.3	1.3
Independent employee representatives	2.1	1.9	1.8	1.8	1.8	1.6	1.7	1.6	1.6	1.6	1.7
Shareholder representatives											
Bank representatives	0.8	0.8	0.7	0.7	0.7	0.6	0.5	0.5	0.5	0.5	0.6
Former managing board member	0.4	0.3	0.3	0.3	0.4	0.4	0.3	0.3	0.3	0.3	0.3
Female representatives	0.8	0.8	0.7	0.8	0.8	0.9	1.0	1.0	0.9	0.9	0.9
Female union representatives	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1
Female works council representatives	0.6	0.6	0.6	0.6	0.7	0.7	0.8	0.8	0.7	0.7	0.7
Observations	203	244	263	263	249	239	230	231	233	227	2382

Table 12: Descriptive statistics on the size and composition of German corporate boards

Note: Table 12 provides descriptive statistics on the size and the composition of supervisory boards for a sample consisting of all German firms listed in the DAX, MDAX, or SDAX for the years 1998 to 2007. The board size and composition data is obtained from annual reports. In this table observations for firms with independent employee representatives, works council representatives, union representatives, bank representatives, and former managing board members do not sum up to the number of observations for all firms as some firms have all of these representatives while others do not.

	Firms with independent representatives		Firms with works council representatives		Firms with union representatives		Firms with bank representatives		Firms with former board members		All firms
	Independent representatives	All representatives	Works council representatives	All representatives	Union representatives	All representatives	Bank representatives	All representatives	Former board members	All representatives	All representatives
Mean	2.69	12.8		3.11	13.86	2.27	15.32	1.5	12.2	1.16	12.21	9.94
Std. Dev.	1.85	5.2		1.64	4.75	0.69	3.76	0.92	6.27	0.39	6.26	5.94
Minimum	0	3		1	6	1	6	1	3	1	3	3
25th percentile	1	9		2	12	2	12	1	6	1	6	6
50th percentile	2	12		3	12	2	14	1	12	1	12	9
75th percentile	4	16		5	20	3	20	2	20	1	20	12
Maximum	9	21		7	21	6	21	10	21	3	21	21
Observations	1,538	1,538		959	959	1,090	1,090	1,014	1,014	686	686	2,382

This finding is confirmed by the Pearson correlation coefficient (see Table 13 for this one and for further correlations). Moreover, the size of the board is negatively correlated with market valuation (*Tobin_Q*), which is in line with prior research and our general expectations. Our measures of employee representation (*union_rep*, *woco_rep*, and *ind_rep*[24]) are positively correlated with board size and other measures of firm size (*sales*, *log_assets*), something we expected since the minimum levels of employee representation are determined by size and regulated by law. It is, therefore, not a surprise either, that the codetermination measures are also highly correlated with each other.

24 All measures of codetermination always add up to the respective form of codetermination, e.g., in the case of parity-codetermination to 0.5

Table 13: Pearson correlation

Note: Table 13 provides Pearson correlations between the main variables used in our model. Values in parentheses show the significance level **, **, and * imply statistical significance at the 0.10, 0.05, and 0.01 levels, respectively.

Table 9
Pearson correlation
Note: Table 9 provides pearson correlations between the main variables used in our model. Values in parentheses show the significance level. ***,**, and * imply statistical significance at the 0.10, 0.05, and 0.01 levels, respectively.

	tobin_q	tot_ret_ind	roe	roic	union_rep	woco_rep	ind_rep	bank_rep	former_bm	experience	sales	leverage	capex_sales	operating_margin
tobin_q	1.00													
tot_ret_ind	0.19 ***	1.00												
roe	0.03	0.12 ***	1.00											
roic	0.18 ***	0.24 ***	0.40 ***	1.00										
union_rep	-0.14 ***	-0.03	0.06 ***	0.04 **	1.00									
woco_rep	-0.15 ***	0.01	0.05 **	0.04 **	0.50 ***	1.00								
ind_rep	-0.05 **	0.02	0.09 ***	0.10 ***	0.23 ***	-0.27 ***	1.00							
bank_rep	0.00	0.00	0.01	-0.03	-0.11 ***	-0.08 ***	-0.14 ***	1.00						
former_bm	0.01	-0.01	-0.04 **	-0.04 **	-0.10 ***	-0.10 ***	0.00	-0.07 ***	1.00					
experience	-0.11 ***	-0.04 **	0.05 **	0.02	0.43 ***	0.32 ***	0.12 ***	0.07 ***	0.00	1.00				
sales	-0.09 ***	-0.02	0.04 *	0.00	0.33 ***	0.26 ***	0.06 ***	-0.01	0.01	0.63 ***	1.00			
leverage	-0.17 ***	-0.10 ***	-0.15 ***	-0.19 ***	-0.09 ***	-0.09 ***	-0.10 ***	0.00	0.07 ***	-0.05 ***	0.02	1.00		
capex_sales	0.00	0.03	0.01	-0.01	-0.03	-0.03	-0.03	0.03	-0.02	0.00	-0.01	0.04 *	1.00	
operating_margin	-0.02	0.09 ***	0.35 ***	0.43 ***	0.02	0.05 **	0.04 **	-0.01	0.02	0.03	0.03	-0.10 ***	0.07 ***	1.00

5.6.2. Estimation Results

Given the descriptive as well as the univariate evidence presented above, we expect a negative impact of board size and our various employee representation variables on market valuation and no statistically significant impact of either bank representatives or former board members. However, the evidence presented so far does not consider other factors that may have an impact on Tobin's Q or total shareholder returns, such as firm size, age, financial structure, operating margin, growth opportunities, diversification, and ownership structure. In the following section we therefore present the results of various fixed-effects regressions[25] including these controls to separate the effect of board size and board composition on firm valuation and performance from the impact of the "control variables".

The results of our first model are displayed in Table 14, columns (1)-(4). Irrespective of the concrete specification of the model, board size seems to have a positive and statistically significant impact on Tobin's Q. The impact of an additional board member is quite significant: based on the average Tobin's Q of 1.52 (see table 7) an additional board member increases Tobin's Q on average by 2.9%. This result is at odds with the findings reported by Yermack (1996) and Eisenberg et al. (1998) who both find a negative impact of board size on valuation in a sample of US companies. However, it confirms the results by Coles et al. (2008) who find that particularly complex firms with greater advising requirements benefit from larger boards.

Regarding the coefficients of our control variables we can confirm a geographic but not an industrial diversification effect (as reported by e.g., Fauver & Fuerst (2006)); geographical diversification has a negative impact on valuation indicating a diversification discount (on average Tobin'Q is reduced by ~11% if the company is geographically diversisified). Furthermore, we are only able to find a significant, negative effect of concentrated ownership (as

25 Random effects estimations and OLS regressions (the latter with heteroskedasticity robust t-values) yield more or less identical results. These are, of course, available from the authors upon request. The same applies to the models we estimated using 2SLS and the Hausman-Taylor estimator to control for (potential) endogeneity of the codetermination variables; additionally, quantile regressions, dynamic panel estimations and the significance of groups of measures of board composition have been tested yielding similar results (once again, these are available from the authors upon request). An estimation using a clustered fixed effects estimation yields similar results with less/no significance for our variables of board size and composition (size is not any longer significant with Tobin's Q and Total return index as dependent variables; the same holds for independent employee representatives with Tobin's Q as dependent variable; results are displayed in the appendix table 3).

reported by e.g., Gorton & Schmid (2004)) for blockholders above 25% (*block_25*; on average Tobin's Q is reduced by 15% if ownership is concentrated above 25%) but not for blockholders above 50% or 75%; this could be due to the fact that concentrated ownership above 25% is sufficient to gain certain influence and is not 'expanded' by ownership above 50% or 75%. The remaining independent variables are in line with our expectations.

Model (2) is different from model (1) insofar as it includes our different measures of board composition in addition to board size. Perhaps surprisingly, the results are almost identical to the ones of model (1). Regarding our measures of employee representation, we only observe a statistically significant and negative effect of the percentage of independent employee representatives (*ind_rep*); the coefficient of the share of works council representatives is also negatively signed, but not significantly different from zero; the same applies to the share of union representatives though positively signed. Thus, according to our point estimate, replacing a union or a works council member of the supervisory board by an independent employee representative on a board with 10 members would be associated with a 7.5% lower Tobin's Q. Moreover, the percentage of former managing board members on the supervisory board is also statistically significant and negative implying that former board members tend to be less devoted and less diligent monitors. The addition of a further former managing board member leads – on average – to reduction of 11% in Tobin's Q.

In model (3) we address the question whether the effect of board size is different across industries. As mentioned above, Coles et al. (2008) find that "complex firms, which have greater advising requirements than simple firms, have larger boards". Since we do not have detailed information on the "complexity" of individual firms, we assume that particularly complex firms mainly occur in complex industries. We therefore introduce in our estimates a series of interaction terms (multiplicative combinations of board size and industry dummies, i.e., manufacturing (SIC 28-29 and 33-39; *size_manu*), trade (SIC 40-49; *size_trade*), and transport (SIC 50-59; *size_transp*). These industries have been identified by Fauver and Fuerst (2006) as sectors that are particularly complex, that is, require "greater coordination, labor involvement, and more specialized employee skill set". Our results (column (3) in Table 10) demonstrate that none of the interaction terms is statistically significant while the remaining independent variables retain their magnitude as well as their level of significance.

Finally, in model (4) we analyze the effect of board composition on market valuation in particularly complex industries by again constructing interaction terms (multiplicative combinations of our measures of board composition (i.e., *union_rep*, *woco_rep*, *ind_rep*, *bank_rep*, and *former_bm*) and the aforementioned industry dummies (manufacturing, trade, and transport)[26]. Only two out of 15 interaction terms are statistically significant: The share of former board managing board members has a significantly positive effect in manufacturing (*former_bm_manu*) as well as in trade (*former_bm_trade*); thus, the addition of a former managing board member to a board of a company in the manufacturing sector increases the Tobin's Q quite significantly by 15.3% on average, and even by 30.9% for companies in the trade business. This confirms our expectation that in complex industries companies benefit from the insider knowledge of former managing board members making them diligent monitors and valuable advisors.

Considering our measures of board composition, we see that the share of works council representatives has a negative significant effect: the addition of a further works council representative (as a replacement of another employee representative) leads to a reduction in Tobin's Q of 13.1% on average. Again the share of independent employee representatives as well as former managing board members is negative (with an average negative effect on Tobin's Q with an additional respective member of 8.4% for independent employee representatives and 18.4% for former managing board members).

The remaining independent variables once more retain their magnitude and their statistical significance.

26 Yielding the following interaction terms: *union_manu*, *union_trade*, and *union_transp* for union representatives in manufacturing, trade, and transportation respectively; *woco_manu*, *woco_trade*, and *woco_transp* for works council representatives in the three industries; *ind_manu*, *ind_trade*, and *ind_transp* for independent employee representatives in the respective industries; *bank_manu*, *bank_trade*, and *bank_transp* for bank representatives in the respective industries; finally, *former_bm_manu*, *former_bm_trade*, and *former_bm_transp* for former managing board members in the respective industries.

Table 14: Fixed-effects regression of Tobin's Q on board size and composition

Note: Models 1-4 of table 14 provide the results of fixed-effects regressions with Tobin's Q (defined as the market value of equity plus the book value of assets minus the book value of equity divided by the book value of assets) on variables of board size and composition and several control variables. All models include dummy variables for year and industry. Z-values are in parentheses. *, **, and *** imply statistical significance at the 0.10, 0.05, and 0.01 levels, respectively.

	Dependent variable: Tobin's Q			
	(1)	(2)	(3)	(4)
size	0.0398***	0.0366**	0.0522***	0.0491**
	(0.0141)	(0.0183)	(0.0177)	(0.0218)
union_rep		0.933		1.555
		(0.901)		(1.171)
woco_rep		-0.588		-1.989**
		(0.700)		(0.985)
ind_rep		-1.138**		-1.268*
		(0.565)		(0.725)
bank_rep		-0.386		-0.619
		(0.327)		(0.429)
former_bm		-1.670***		-2.798***
		(0.393)		(0.507)
exp_datab		-0.00463		-0.00653
		(0.00837)		(0.00848)
log_ass	-0.493***	-0.499***	-0.491***	-0.508***
	(0.0403)	(0.0402)	(0.0403)	(0.0403)
sales	1.48e-08**	1.48e-08**	1.50e-08**	1.47e-08**
	(6.41e-09)	(6.40e-09)	(6.41e-09)	(6.40e-09)
ind_divers	-0.0530	-0.0492	-0.0507	-0.0499
	(0.0561)	(0.0561)	(0.0563)	(0.0569)
geo_divers	-0.169**	-0.177**	-0.172**	-0.177**
	(0.0755)	(0.0755)	(0.0760)	(0.0767)
herfindahl	-0.00155	-0.00137	-0.00161	-0.000494
	(0.00242)	(0.00242)	(0.00243)	(0.00248)
block_25	-0.232***	-0.232***	-0.234***	-0.220***
	(0.0661)	(0.0659)	(0.0661)	(0.0662)
block_50	0.0531	0.0608	0.0539	0.0552
	(0.0723)	(0.0723)	(0.0725)	(0.0725)
block_75	0.00164	-0.0337	-0.000431	-0.0465
	(0.0858)	(0.0860)	(0.0860)	(0.0868)
leverage	-0.245	-0.199	-0.246	-0.235
	(0.150)	(0.150)	(0.150)	(0.150)
capex_sales	-0.000347	-0.00192	-0.000687	-0.00273
	(0.0217)	(0.0216)	(0.0217)	(0.0216)
operating_margin	-0.00106	-0.00114	-0.00102	-0.00116
	(0.000726)	(0.000724)	(0.000728)	(0.000724)
restruct	-0.554***	-0.558***	-0.554***	-0.560***
	(0.208)	(0.208)	(0.208)	(0.209)
m_and_a	0.409***	0.362**	0.413***	0.359**
	(0.141)	(0.143)	(0.141)	(0.145)

Table 14 (continued)

	Dependent variable: Tobin's Q			
	(1)	(2)	(3)	(4)
size_manu			-0.0405	-0.0529
			(0.0335)	(0.0450)
size_trade			-0.0273	0.104
			(0.0622)	(0.124)
size_transp			-0.0173	0.0385
			(0.0514)	(0.0859)
union_manu				-0.103
				(2.064)
union_trade				-6.263
				(5.133)
union_transp				1.390
				(6.288)
woco_manu				2.425
				(1.539)
woco_trade				2.933
				(5.715)
woco_transp				0.148
				(4.365)
ind_manu				0.866
				(1.299)
ind_trade				-0.793
				(5.340)
ind_transp				-2.233
				(3.341)
bank_manu				0.0369
				(0.808)
bank_trade				0.601
				(1.184)
bank_transp				1.453
				(0.995)
former_bm_manu				2.325***
				(0.896)
former_bm_trade				4.702***
				(1.453)
former_bm_transp				2.056
				(2.352)
Constant	8.137***	8.507***	8.174***	8.537***
	(0.546)	(0.557)	(0.547)	(0.576)
Observations	2,382	2,382	2,382	2,382
R^2	0.165	0.175	0.166	0.186

To evaluate the effect of board size and composition on performance we replace Tobin's Q by another measure of capital market performance, the total return to shareholders (*tot_ret_ind*). The results of the four models (that are identical to the ones reported in Table 14) are displayed in Table 15. The result is quite surprising insofar as the effect of board size is completely different from the one in our estimation with Tobin's Q as the dependent variable. In model (1) to (3) board size has a significantly negative effect on total return to shareholders (on average the total return index is 4.6% lower when an additional member is added to the board). This is in line with our expectations and with the findings of Yermack (1996) and Eisenberg et al. (1998). Another puzzling result is the statistically significant and negative effect of leverage and the operating margin on total shareholder return (the increase of financial leverage by one percentage point decreases the total return index by 1% on average). We do not have a convincing explanation for these effects and can, therefore, only refer to similar results reported by Loderer & Waelchli (2009).

In model (2) we find a similar sized statistically significant and negative effect of board size on total shareholder return (as mentioned above). Board composition, however, seems to be of minor importance, because only the percentage of former managing board members (*former_bm*) seems to affect shareholder returns in a significant and positive way (the effect of an additional former managing board member increases the total return index by 9.0% on average). This latter finding is in line with our prediction that companies may benefit from the insider knowledge of former managing board members, especially in their role of advisors (see above). The coefficients of the remaining independent variables are in line with the ones in model (1).

In model (3) we observe about the same effects as in model (2). Contrary to the findings reported in Table 14, however, none of the interaction terms between board size and the dummies for complex industries reaches conventional levels of statistical significance.

Finally, model (4) yields similar results as models (2) and (3). Regarding the interaction terms between board composition and industry, we again do not observe any statistically significant effect of our interaction terms. The remaining interaction variables are all statistically insignificant.

Table 15: Fixed-effects regression of total return to shareholders on board size and composition

Note: Models 1-4 of table 15 provide the results of fixed-effects regressions with total return to shareholders (defined as total return including capital gains as well as possible dividend payments) on variables of board size and composition and several control variables. All models include dummy variables for year and industry. Z-values are in parentheses. *, **, and *** imply statistical significance at the 0.10, 0.05, and 0.01 levels, respectively.

	Dependent variable: Total Return Index			
	(1)	(2)	(3)	(4)
size	-8.613***	-8.489**	-8.359**	-6.949
	(2.910)	(3.800)	(3.657)	(4.560)
union_rep		-48.57		-205.2
		(187.1)		(244.5)
woco_rep		7.357		-55.18
		(145.5)		(205.7)
ind_rep		67.93		136.8
		(117.4)		(151.3)
bank_rep		62.14		31.86
		(67.99)		(89.50)
former_bm		112.6		138.4
		(81.55)		(105.9)
exp_datab		1.468		1.314
		(1.739)		(1.771)
log_ass	181.6***	181.9***	181.7***	182.5***
	(8.326)	(8.351)	(8.342)	(8.421)
sales	-1.88e-06	-1.80e-06	-1.87e-06	-1.79e-06
	(1.32e-06)	(1.33e-06)	(1.33e-06)	(1.34e-06)
ind_divers	11.33	10.81	11.42	11.40
	(11.60)	(11.66)	(11.63)	(11.88)
geo_divers	13.31	14.44	13.06	16.57
	(15.61)	(15.67)	(15.71)	(16.01)
herfindahl	-0.178	-0.210	-0.178	-0.161
	(0.501)	(0.502)	(0.503)	(0.517)
block_25	-14.57	-14.84	-14.65	-15.47
	(13.65)	(13.69)	(13.67)	(13.82)
block_50	2.466	2.297	2.395	1.791
	(14.95)	(15.02)	(14.99)	(15.13)
block_75	-2.088	0.939	-2.219	1.975
	(17.74)	(17.86)	(17.78)	(18.11)
leverage	-162.1***	-164.3***	-162.2***	-163.7***
	(30.96)	(31.14)	(31.00)	(31.42)
capex_sales	8.572*	8.831**	8.557*	8.943**
	(4.488)	(4.494)	(4.492)	(4.511)
operating_margin	-0.258*	-0.249*	-0.257*	-0.253*
	(0.150)	(0.150)	(0.150)	(0.151)
restruct	24.75	23.46	24.61	25.06
	(42.98)	(43.11)	(43.04)	(43.66)

Table 15 (continued)

	Dependent variable: Total Return Index			
	(1)	(2)	(3)	(4)
m_and_a	42.28	49.84*	42.41	42.84
	(29.19)	(29.69)	(29.22)	(30.24)
size_manu			-1.233	-5.303
			(6.925)	(9.394)
size_trade			-0.129	-7.635
			(12.87)	(25.93)
size_transp			0.489	-0.387
			(10.62)	(17.93)
union_manu				433.8
				(430.9)
union_trade				579.9
				(1,072)
union_transp				418.6
				(1,313)
woco_manu				-5.187
				(321.3)
woco_trade				981.0
				(1,193)
woco_transp				-269.5
				(911.2)
ind_manu				-210.4
				(271.2)
ind_trade				460.4
				(1,115)
ind_transp				-237.3
				(697.4)
bank_manu				-6.642
				(168.6)
bank_trade				221.1
				(247.2)
bank_transp				130.3
				(207.6)
former_bm_manu				-32.29
				(187.0)
former_bm_trade				-144.8
				(303.3)
former_bm_transp				-202.4
				(490.9)
Constant	-2,126***	-2,153***	-2,126***	-2,164***
	(112.8)	(115.7)	(113.1)	(120.3)
Observations	2,382	2,382	2,382	2,382
R^2	0.280	0.282	0.280	0.284

Overall, we find no consistent impact of either board size or board composition on the market valuation of listed German companies. The significant differences in the magnitude

and the direction of our explanatory variables suggest a high degree of sensitivity of our results: Replacing one measure of market valuation by another (Tobin's Q vs. total shareholder return) leads to completely different findings. This, in turn, suggests that the incompatible results that have been presented in the literature so far are not really surprising, but may the result of a number of theoretical as well as methodological shortcomings. To provide additional evidence on the impact of board size and board composition on company performance we now replace in our estimations the market valuation measures by measures of a company's operating performance, i.e., accounting data such as return on equity (*ROE*) and return on invested capital (*ROIC*).

Table 16 displays the results of the four different models with return on equity (*ROE*) as the dependent variable. In model (1) only the logarithm of total assets (*log_ass*), leverage, the operating margin, and the dummy variable indicating restructuring (*restruct*) turn out to be statistically significant. While the impact of total assets suggests higher return on equity for larger companies, we again observe the negative effect of leverage. Furthermore, both the positive effect of operating margin and the negative effect of restructuring activities on return on equity are in line with our expectations. No other right-hand side variable approaches conventional levels of statistical significance. Model (2) is quite similar; the only difference here is the significantly negative effect of former board members on return on equity; an additional former managing board member leads to a reduction 81% of median RoE. As mentioned above, this could be due to the fact that the former managing board members are lenient monitors and poor advisors. Model (3) is again similar to models (1) and (2) with the exception that industrial diversification (*ind_divers*) has a statistically significant, negative effect on RoE (on average industrially diversified companies reduces median RoE by 93%). With regard to the interaction terms (board size and industry dummies), we observe a significantly negative effect of board size in trade, suggesting that a larger board might not be beneficial in the (presumably complex) trade industry (not in line with Coles et al. (2008)); the effect is quite significant as median RoE is on average reduced by 10.2% when an additional board member is added. Finally, in model (4) we find a significant and positive effect of codetermination in trade; all three measures of union, works council, and independent employee representatives have a significant positive effect (an addition of an additional union member in the trade industry leads to an increase in median RoE of 118% on average, 78% for an additional works council member and 59% for an additional independent employee representa-

tive). The remaining independent variables show similar significance and direction as in model (3).

Table 16: Fixed-effects regression of return on equity (ROE) on board size and composition

Note: Models 1-4 of table 16 provide the results of fixed-effects regressions with return on equity (defined as net income before preferred dividends minus preferred dividends divided by last year's common equity) on variables of board size and composition and several control variables. All models include dummy variables for year and industry. Z-values are in parentheses. *, **, and *** imply statistical significance at the 0.10, 0.05, and 0.01 levels, respectively.

	Dependent variable: Return on Equity			
	(1)	(2)	(3)	(4)
size	1.472	1.178	2.432	2.854
	(1.333)	(1.740)	(1.672)	(2.074)
union_rep		54.33		2.315
		(85.65)		(111.2)
woco_rep		-71.50		-94.24
		(66.60)		(93.55)
ind_rep		-48.88		-39.84
		(53.75)		(68.80)
bank_rep		-19.24		-5.612
		(31.13)		(40.70)
former_bm		-79.44**		-126.0***
		(37.33)		(48.14)
exp_datab		0.188		0.193
		(0.796)		(0.805)
log_ass	7.391*	7.186*	7.493**	7.658**
	(3.814)	(3.823)	(3.813)	(3.830)
sales	4.11e-07	4.36e-07	4.24e-07	4.56e-07
	(6.07e-07)	(6.09e-07)	(6.06e-07)	(6.07e-07)
ind_divers	-8.333	-8.615	-9.073*	-8.640
	(5.314)	(5.336)	(5.318)	(5.404)
geo_divers	-10.47	-10.56	-10.09	-9.574
	(7.151)	(7.176)	(7.179)	(7.280)
herfindahl	0.154	0.153	0.0978	-0.0423
	(0.229)	(0.230)	(0.230)	(0.235)
block_25	-5.623	-5.429	-5.824	-4.421
	(6.253)	(6.267)	(6.251)	(6.283)
block_50	8.354	8.671	8.732	9.047
	(6.847)	(6.875)	(6.851)	(6.882)
block_75	9.793	8.119	9.545	7.291
	(8.127)	(8.175)	(8.130)	(8.238)
leverage	-78.27***	-76.27***	-76.92***	-75.54***
	(14.18)	(14.26)	(14.17)	(14.29)

Table 16 (continued)

	Dependent variable: Return on Equity			
	(1)	(2)	(3)	(4)
capex_sales	-3.051	-3.087	-3.047	-3.004
	(2.055)	(2.058)	(2.053)	(2.051)
operating_margin	1.075***	1.073***	1.079***	1.071***
	(0.0688)	(0.0688)	(0.0688)	(0.0687)
restruct	-35.06*	-34.97*	-33.06*	-28.38
	(19.69)	(19.73)	(19.67)	(19.86)
m_and_a	-16.35	-17.06	-15.86	-20.15
	(13.37)	(13.59)	(13.36)	(13.75)
size_manu			0.590	-1.104
			(3.166)	(4.272)
size_trade			-16.58***	-57.38***
			(5.881)	(11.79)
size_transp			-2.492	-1.741
			(4.854)	(8.153)
union_manu				125.2
				(196.0)
union_trade				1,931***
				(487.3)
union_transp				50.35
				(597.0)
woco_manu				-46.61
				(146.1)
woco_trade				1,275**
				(542.6)
woco_transp				82.62
				(414.4)
ind_manu				12.23
				(123.3)
ind_trade				960.2*
				(507.0)
ind_transp				-20.07
				(317.2)
bank_manu				-58.64
				(76.67)
bank_trade				-62.70
				(112.4)
bank_transp				9.568
				(94.42)
former_bm_manu				127.7
				(85.03)
former_bm_trade				116.2
				(137.9)
former_bm_transp				197.9
				(223.3)
Constant	-89.27*	-70.07	-81.77	-67.42
	(51.65)	(52.96)	(51.71)	(54.69)
Observations	2,382	2,382	2,382	2,382
R^2	0.146	0.149	0.150	0.162

We now turn to a discussion of our final set of regressions with return on invested capital as the dependent variable (see Table 17). In model (1) board size remains statistically insignificant while firm size (as measured by the logarithm of total assets *log_ass*) once again turns out to affect firm performance positively. Furthermore, we once again find a positive effect of our measure for industry concentration (*herfindahl*) indicating that the return on invested capital is higher in concentrated industries (the effect is minimal though: a 1% increase in the index leads to a 0.03% increase in ROIC); this is in line with our expectations. Again, we replicate the significantly negative effect of leverage and the ratio of capital expenditures to sales (*capex_sales*). The positive effect of the operating margin, however, is once again in line with our expectations. Model (2) yields similar results with only two of the variables measuring board composition reaching statistical significance: the share of works council representatives as well as of former managing board members have a significant and negative impact on return on invested capital; the addition of a further works council representative reduces the ROIC on average by 39%, the addition of a further former managing board member by 27%.

Model (3) shows an almost identical pattern of results. While almost all control variables retain their magnitude and level of significance, none of the interaction terms turns out to be statistically significant.

Finally, model (4) leads to virtually identical results as the previous models. While the coefficient of board size is statistically significant (at the 10% level) and positive in general, it retains its negative impact in the trade sector; i.e., increasing the size of the board by one member leads to an increase of 10.6% in ROIC on average, in the trade sector this effect is negative with a decrease of 8.6% on average. While the remaining independent variables of model (3) show the same magnitude and level of significance none of the interaction terms show any significance.

Table 17: Fixed-effects regression of return on invested capital (ROIC) on size and board composition

Note: Models 1-4 of table 17 provide the results of fixed-effects regressions with return on invested capital (defined as net income before preferred dividends plus interest expense on debt minus interest capitalize times one minus tax rate divided by average of last year's and current year's total capital plus last year's short term debt and current portion of long term debt) on variables of board size and composition and several control variables. All models include dummy variables for year and industry. The number of observations is slightly lower due to data availability issues. Z-values are in parentheses. *, **, and *** imply statistical significance at the 0.10, 0.05, and 0.01 levels, respectively.

	Dependent variable: Return on Invested Capital			
	(1)	(2)	(3)	(4)
size	0.303	0.470	0.373	0.707*
	(0.262)	(0.342)	(0.329)	(0.409)
union_rep		-8.540		-1.218
		(16.82)		(21.93)
woco_rep		-25.85**		-49.52***
		(13.08)		(18.45)
ind_rep		-1.569		-5.758
		(10.55)		(13.57)
bank_rep		3.579		8.884
		(6.111)		(8.026)
former_bm		-17.84**		-21.60**
		(7.330)		(9.494)
exp_datab		0.0339		0.0355
		(0.156)		(0.159)
log_ass	3.109***	3.175***	3.136***	3.236***
	(0.750)	(0.751)	(0.751)	(0.755)
sales	2.99e-08	3.61e-08	3.10e-08	3.59e-08
	(1.19e-07)	(1.20e-07)	(1.19e-07)	(1.20e-07)
ind_divers	-1.066	-1.211	-1.121	-1.214
	(1.045)	(1.048)	(1.047)	(1.066)
geo_divers	-1.876	-1.774	-1.990	-1.796
	(1.406)	(1.409)	(1.414)	(1.436)
herfindahl	0.194***	0.193***	0.189***	0.174***
	(0.0451)	(0.0451)	(0.0453)	(0.0464)
block_25	-1.799	-1.636	-1.865	-1.529
	(1.230)	(1.231)	(1.231)	(1.239)
block_50	1.635	1.484	1.590	1.385
	(1.346)	(1.350)	(1.349)	(1.357)
block_75	-0.273	-0.421	-0.384	-0.695
	(1.598)	(1.605)	(1.601)	(1.625)
leverage	-14.25***	-13.71***	-14.17***	-13.98***
	(2.789)	(2.799)	(2.791)	(2.818)
capex_sales	-0.836**	-0.809**	-0.842**	-0.812**
	(0.404)	(0.404)	(0.404)	(0.405)
operating_margin	0.243***	0.243***	0.244***	0.243***
	(0.0135)	(0.0135)	(0.0135)	(0.0136)
restruct	2.902	2.701	2.995	2.733
	(3.871)	(3.875)	(3.875)	(3.915)

Table 17 (continued)

	Dependent variable: Return on Invested Capital			
	(1)	(2)	(3)	(4)
m_and_a	0.671	0.670	0.764	0.707
	(2.629)	(2.669)	(2.631)	(2.712)
size_manu			-0.192	-0.303
			(0.623)	(0.842)
size_trade			-1.455	-5.363**
			(1.158)	(2.326)
size_transp			0.612	-0.0605
			(0.956)	(1.608)
union_manu				-23.18
				(38.65)
union_trade				176.6*
				(96.10)
union_transp				17.14
				(117.7)
woco_manu				34.94
				(28.82)
woco_trade				118.7
				(107.0)
woco_transp				68.03
				(81.72)
ind_manu				19.40
				(24.32)
ind_trade				49.01
				(99.98)
ind_transp				10.87
				(62.54)
bank_manu				-8.626
				(15.12)
bank_trade				-24.64
				(22.17)
bank_transp				-8.791
				(18.62)
former_bm_manu				14.99
				(16.77)
former_bm_trade				9.691
				(27.20)
former_bm_transp				22.80
				(44.03)
Constant	-32.07***	-31.09***	-31.26***	-30.86***
	(10.16)	(10.40)	(10.18)	(10.78)
Observations	2,382	2,382	2,382	2,382
R^2	0.202	0.207	0.203	0.213

Summarizing, board size and board composition seem to have consistent, yet statistically insignificant and economically irrelevant effects on the two different accounting measures of performance that we use in our estimations: Neither return on equity nor return on invested capital is affected by the size of corporate boards in German companies. Moreover, board composition seems to be irrelevant too. If anything, the percentage of former managing board members and the percentage of works council representatives seem to have a significantly negative, yet economically weak impact in some of the specifications.

5.7. Discussion and Conclusion

Using the by far largest and most comprehensive data set available, we analyze the impact of board size and board composition on the capital market as well as the operating performance of German companies. Irrespective of the concrete model specification and the estimation technique employed we fail to find a consistent and economically relevant influence of both, board size and board composition. While we find a significantly positive influence of board size on Tobin's Q, the impact on total shareholder return is significantly negative. With respect to operating performance (measured by return on equity and return on invested capital) we end up with insignificant coefficients of board size, suggesting that it is completely irrelevant in this respect. Board composition, in turn, seems to have no pronounced effect on our measures of operating performance either.

Explaining these unexpected results – which may be disputed by both, proponents as well critics of mandated employee representation on supervisory boards – is not trivial. We suggest the following route: To the extent that worker readiness to invest in the acquisition of firm specific skills requires the existence of particular "safeguards" that protect them against employer opportunism, worker representatives on corporate boards may not only increase the individual worker's motivation and loyalty, but also to foster investments that, upon completion, increase productivity only in a particular firm, but nowhere else. Without an institutional arrangement that deters employer opportunism, under-investment is likely to occur. Thus, although a voluntary introduction of participatory institutions in general and of codetermination in particular is not to be expected, firms and workers are likely to benefit both from mandatory employee participation in terms of an increasing joint surplus. How this surplus will in each particular case be shared and whether the process of "dividing the pie" will lead to (additional) conflicts is difficult to predict. It is safe to conclude, however, that the highly complex

German system of labor relations firms has played an important role in shaping worker motivations and expectations. This complexity is due to the interplay of a large number of complementary elements (including e.g., detailed regulations related to initial as well as further training, dismissal protection legislation, workplace health and safety regulations, etc.) that form a consistent system. Particular changes of or amendments to this system are likely to result in unintended side effects that are, in turn, detrimental to firms and workers alike (see e.g., Milgrom & Roberts (1990) and (1995)). Although plausible, we are far from saying that this is the only possible explanation for the relative success of the German variant of "stakeholder capitalism". Further empirical analyses are urgently required to convincingly demonstrate the explanatory power of our approach. Moreover, what also needs to be investigated theoretically as well as empirically is whether and to what extent "internal governance mechanisms" – such as worker representatives on supervisory boards – are substitutes for underdeveloped "external governance mechanisms" (e.g., the capital market).

6. Who is the Better Monitor? The Impact of Female Board Directors, Board Composition, and Board Size on Earnings Management

6.1. Introduction

Workforce diversity – be it at the shop floor or at the (top) management level – is a topic that is currently receiving a lot of attention not only in political debates and the popular press, but also in the social sciences in the field of corporate finance and accounting. While this is particularly true for the United States, systematic research remains limited in Europe. At the same time, however, top managers seem to be on the forefront of the discussion in (Western) Europe:

> "*The management board consists of white males only. Our top 600 managers are predominantly white German males. We are too one-dimensional*" (Peter Löscher, CEO Siemens AG, in: Financial Times, June 24th 2008).
>
> "*Sweden begins effort to get more women onto company boards*" (Wall Street Journal, September 9th 2009).
>
> "*More female supervisory board members are necessary. Their appointment, however, should be based on qualification, not on quotas*" (Christian Strenger, member of the German Corporate Governance Codex Commission, in: Frankfurter Allgemeine Zeitung, November 16th 2009).

Thus, while the attention in politics and the popular press is quite high, the issue has not been discussed in detail in academia, something that is especially the case for Germany. Research on the impact and the consequences of workforce diversity in general remains limited and is – so far – completely absent when it comes to diversity of management and/or supervisory boards. However, board diversity has for years already been of interest to many economists and management scholars studying the Anglo-Saxon "one-tier system" of corporate governance.

The main goal of our paper is to contribute to the discussion of the impact of gender diversity on the behavior of corporate boards in Germany, i.e., a country with a two-tier system, where simultaneous membership on the management and the supervisory board is strictly forbidden and where – at least in large companies – worker representatives are guaranteed a certain number of seats on the supervisory boards. Thus, we are particularly interested in the impact of board size, board composition and board diversity on earnings management in large

German firms. Our data set includes almost all companies that have been listed in one of the large German indices (DAX, MDAX and SDAX) for at least two consecutive years in the period 1998-2007 (n=294 firms with 2,334 firm-year-observations). Our main result is that female board members are associated with less earnings management and thus seem to be more diligent monitors. Female employee representatives, not female shareholder representatives are mainly responsible for this positive effect. More specifically, it is female independent employee representatives and not female union or works council representatives that account for this result. With regard to board size and other variables of board composition (e.g., auditors, lawyers) do not find any consistent evidence.

Women are still underrepresented on corporate boards around the world. This is particularly true for supervisory boards in Germany. While the percentage of women on the supervisory boards of the largest German listed companies (members of the indices DAX, MDAX, SDAX) has slightly increased from 7.0% in 1998 to 7.8% in 2007, it still remains low compared to e.g., the US with 15% female members in Fortune 500 boards in 2007 (Adams and Ferreira (2009) or Norway with 42% and Sweden with 27% (Holst and Wiemer (2010); Catalyst (2009)). Furthermore, most female board members (about 80%) in Germany are employee representatives. This means that at most 20% of the already low percentage of female board members are shareholder representatives.

Given the recent increase in the percentage of women on corporate boards across Europe (from e.g., 32% to 42% in Norway, 6% to 15% in the Netherlands and 4% to 10% in Spain) the current situation is likely to change in Germany as well: An increasing number of politicians as well as (male) top managers seem to favor a binding quota, a step that has already been taken by a number of European governments already: The Swedish government for example announced that firms failing to reserve 25% of their board seats for females will be dissolved (see Medland (2004)). The Norwegian government has already enacted a law requiring all listed companies to fill 40% of their board seats with female directors. Finally, the Spanish government requires all companies to increase the percentage of female directors to 40% in 2015. From a policy perspective it is, therefore, interesting to see whether a higher percentage of female board members is associated with a better company performance as this would make the arguments of the proponents of a quota system more convincing.

The remainder of the paper is organized as follows. Section 6.2 includes a brief review of the available literature on board diversity and earnings management while section 6.3 describes the legal background of corporate boards in Germany. Section 6.4 presents the data and section 6.5 the empirical methodology. Our results are displayed in section 6.6 while section 6.7 concludes the paper.

6.2. Corporate Governance, Board Diversity and Earnings Management

6.2.1. Earnings Management and Corporate Governance

"*Earnings management occurs when managers use judgment in financial reporting and in structuring transactions to alter financial reports to either mislead some stakeholders about the underlying economic performance of the company or to influence contractual outcomes that depend on reported accounting numbers*" (Healy and Wahlen (1999)).

It is a generally accepted opinion in financial management and financial economics that the discounts companies have to incur for their inability to meet or beat analyst expectations is the main reason for earnings management[27]. Following the increase in the number of corporate scandals around the world – very often attributed to a "failure" of the governance and monitoring system implemented in the various economies – the academic literature started to take a closer look at the relationship between "good governance" and its effect on accounting discretion. In one of the first studies, Beasley (1996) shows that based on a sample of 75 fraud and 75 comparable no-fraud firms in the period of 1980-1991 no fraud firms have a significantly higher percentage of outside directors. The author takes this as prima facie evidence come that outside directors increase a board's effectiveness in monitoring the management team. Moreover, he observes that the likelihood of financial statement fraud increases with board size. This confirms Jensen's (1993) view that generally smaller boards are better in monitoring. Vafeas (2000), in turn, suggests that companies with smaller boards are more closely monitored and that, therefore, investors expect these firms to publish more "informative" earnings figures. While the former author does not find a relationship between the percentage of outside directors and earnings management, Klein (2002) documents a statistically significant negative relationship between board independence and abnormal accruals, suggest-

27 In a somewhat outdated, yet still very interesting review of the relevant literature Fields and Keys (2003) collect evidence that the percentage of firms beating analyst estimates has considerably increased in the last two decades.

ing that more independent boards are better monitors. This latter finding is corroborated by Xie, et al. (2003) who find that board members with a corporate or finance background are associated with firms that have smaller discretionary current accruals.

These results are confirmed by more recent research: Cornett, et al. (2008) find that the quality of the reported earnings increases with the quality of the monitoring in place. The quality of monitoring, in turn, increases c.p. with the percentage of independent outside directors on the board. Similar results are found by Cornett, et al. (2009), who observe for large U.S. bank holding companies that board independence is positively related to earnings and negatively related to earnings management[28].

6.2.2. Gender Diversity and Earnings Management

To the best of our knowledge, the only study that is available on this topic is the one by Parsons and Krishnan (2006): Based on a sample including 770 firm-year-observations from 353 Fortune 500 companies in the years 1996-2000, the authors find that "earnings quality is positively associated with gender diversity in senior management" (Parsons and Krishnan (2006)).

6.2.3. Gender Diversity and Corporate Governance

Gender diversity in the workforce has received (and continues to receive) enormous attention, both in academia and in the popular press. While the initial research addressed the existence of a “glass ceiling”, i.e., the reasons why women in lower and middle management positions had poor advancement opportunities, the more recent research has started to analyze the careers and the behavior of women in top management and on corporate boards (e.g., Kesner (1988), Bilimoria and Piderit (1994), Daily and Dalton (1994), Carter, et al. (2003)).

To date, only few studies exist that analyze the link between corporate governance and gender diversity (for a survey of the early literature see Fields and Keys (2003)). As already mentioned above, this is surprising insofar as this topic receives high attention in the political debate. Using a cross-section of large US firms (*Fortune 1000*) with 797 observations, Carter

28 Additionally, García-Meca and Sánchez-Ballesta (2009) provide a comprehensive summary over the recent research in the area of corporate governance and earnings management.

et al. (2003) find a significantly positive relationship between the percentage of women and ethnic minorities on the board and firm value.

Farrell and Hersch (2005) take a different perspective and estimate the probability of a particular firm to appoint a female board member. Based on 2,974 observations from Fortune 500 and Service 500 firms for the years 1990-1999, the authors find that adding another director to the board is not gender neutral: The probability of adding a female director to the board is, first, negatively affected by the number of women already serving on the board. Second, the probability of adding a female member is increased if a woman leaves the board.

The a more recent study, Adams and Ferreira (2009) find that female directors have a significantly positive impact on "board inputs and firm outcomes". Using a large sample of US firms covering a period of more than fifteen years (1996-2003 with more than 8,000 firm-year-observations) they show that, first, female directors have better attendance records at board meetings than men and that, second, a higher percentage of female directors is associated with a better attendance record of male directors too. Moreover, CEO turnover is more sensitive to share price performance in companies with a higher percentage of female board members. The same holds true for equity-based compensation, i.e., the higher the percentage of female directors, the higher the percentage of performance-related pay of the top managers. However, contrary to findings that have been quoted over and over again in the popular press (e.g., Catalyst (2007)) documenting a superior performance of companies with more female board members, Adams and Ferreira (2009) are unable to find such a relationship when controlling for the endogeneity of gender diversity. They only find a significantly positive effect on performance for firms whose owners suffered from weak governance in the past[29].

6.3. Legal and Institutional Background

The German system of corporate governance is fundamentally different from the Anglo-Saxon one: while the latter system has as its main goal the maximization of the returns to shareholders (Shleifer and Vishny (1997)), the German system tries to take the interests of all stakeholders into account with management trying to include the respective groups' varying views in its corporate decision making (Fauver and Fuerst (2006)). More specifically, a publicly held German company (*Aktiengesellschaft*) is governed by a two-tiered board structure, consisting of the management board (*Vorstand*) and the supervisory board (*Aufsichtsrat*). The

29 Terjesen, et al. (2009) provide a good overview of further recent research on corporate governance and gender diversity.

management board consists of the executive directors who are responsible for running the firm on a day-to-day basis and for developing and implementing its strategy. The supervisory board has, to a large extent, similar duties as the US board of directors as it is responsible for appointing the members of the management board and for their remuneration. The fundamental difference between the German and the US system is that, first, the management board reports to the supervisory board and, second, that no management board member can be a member of the supervisory board.

The size and the composition of the supervisory board is to a great extent dictated by law: Depending on the number of employees, the legal form of the company, and the statutory equity, board size varies between 3 and 21 seats. Moreover, again depending on the number of employees and the industry affiliation of the company, employee representation can take three different forms: No mandatory representation, one-third representation and one-half-representation. The composition of the group of employee representatives is further regulated by law: Depending on the number of employee representatives, one, two, or three union representatives have to be appointed members of the supervisory board.

With regard to gender, no such regulation exists. Although an increasing number of German politicians and even top managers support the implementation of a mandated quota like in Norway or Spain, the most recent version of the German corporate governance codex of June 2009 only gives a vague recommendation with regard to the composition of the supervisory board: "*Furthermore, attention shall also be paid to […] diversity*" (Regierungskommission Deutscher Corporate Governance Kodex (2009)).

6.4. Sample and Data Sources

6.4.1. Sample Composition

Our initial data set includes all publicly listed German companies that were listed for at least one year in one of the three largest German indices – DAX, MDAX, or SDAX – during the period 1998-2007. In a first step, we deleted all companies for which only one year of information was available (n=7). This resulted in a sample including 306 companies with 2,476 observations. Second, we deleted all companies that are incorporated as *Kommanditgesellschaft auf Aktien* (KGaA), as this is a hybrid organizational form between a partnership and a stock corporation, and all foreign companies as these are not subject to the German law.

This leaves us with a final data set that comprises 2,334 observations from 292 different firms.

6.4.2. Data Sources

The data on supervisory board composition is hand-collected from annual reports. Reports not available from the respective company's website were obtained from the annual report database of the *Schutzgemeinschaft der Kapitalanleger e.V.* (German Association for the Protection of Shareholders) and from various archives in Germany (Archive of the Bavarian Chamber of Commerce, Archive of the University of Bremen, Archive of the University of Cologne). Finally, if no reports were available, data for supervisory board composition was assembled using the *Hoppenstedt Jahrbuch der Großunternehmen* (Hoppenstedt Annual Review of the Largest German Companies). Measures of accounting performance as well as information on business and geographic segments were obtained from Thomson Reuters Worldscope. Missing accounting data in Worldscope was added from the companies' annual reports. Data on market capitalization was obtained from Datastream. Finally, we also added information concerning special company specific events (restructurings, mergers & acquisitions) based on an extensive press search.

6.5. Methodology

6.5.1. Variables

Our analysis consists of a series of fixed effects regressions to determine the impact of board size and board composition (particularly of gender diversity) on measures of earnings management.

As a measure of earnings management we consider discretionary accruals: Similar to Leuz, et al. (2003) and Burghstahler, et al. (2006) we assume that earnings are temporarily inflated due to accrual choices while at the same time cash flow remains unaffected. Thus, we use the value of accruals divided by the cash flow from operations as our preferred measure of

earnings management (*acc_cfo*). We calculate accruals similar to Dechow, et al. (1995) as follows[30]:

$$Accruals_{it} = (\Delta CA_{it} - \Delta Cash_{it}) - (\Delta CL_{it} - \Delta STD_{it}) - DEP_{it} \quad (1)$$

where ΔCA_{it} = change in total current assets, $\Delta Cash_{it}$ = change in cash and cash equivalents, ΔCL_{it} = change in total current liabilities, ΔSTD_{it} = change in short term debt, and DEP_{it} = depreciation and amortization expense for firm *i* in year *t*. If a company does not report short-term debt, we assume the change to be zero.

Due to data availability issues and the limited number of industry-specific observations we are unfortunately not able to use further measures of earnings management as suggested by Leuz, et al. (2003) and Burghstahler, et al. (2006) to ensure the robustness of our results and to reduce the influence of potential errors.

To deal with possible shortcomings of only one measure of earnings management we use a slightly modified measure of accrual discretion. As suggested by Dechow, et al. (1995) we scale total accruals by lagged total assets instead of cash flow from operations (*acc_sca)*. Following Burghstahler, et al. (2006) we have truncated ("winzorized") both earnings management measures, reducing the top 10% values to the next highest value.

As independent variables we use in our estimations a number of variables measuring female representation on the supervisory board. First, *perc_fem* is the percentage of female directors[31]. Second, we further distinguish between female employee representatives (*emp_fem*) and female shareholder representatives (*share_fem*). Finally, we make an additional distinction and classify the female employee representatives according to the institution that nominated them, e.g., female union representatives (*union_fem*), female works council representatives (*woco_fem*) and female independent employee representatives (*ind_fem*). Generally, we expect a positive effect of female board members on earnings management (i.e., less earnings management) as Adams and Ferreira (2009) find that "*gender-diverse boards allocate more effort to monitoring*"[32].

30 Due to data availability issues we left out changes in income taxes payable as included in the work of Leuz, et al. (2003).

31 Calculated as the absolute number of female directors divided by the board size at the end of the financial year (as reported in the annual report)

32 This effect, however, could be limited by "excessive" gender diversity because this is said to lead to "over-monitoring" (see Adams and Ferreira (2009)).

As measures of board size and composition we first use the absolute number of board seats at the end of the financial year (*board_size* and *board_size2*) as displayed in the annual report. In line with previous research (see section 6.2.1 above) we expect that smaller boards have a superior monitoring technology and that, therefore, the management of companies with smaller boards is less susceptible to earnings management. As further measures of board composition we include the percentage of bank representatives on the board (*bank_rep*[33]) because in line with Xie, et al. (2003) we expect a positive effect of bank representatives on earnings measurement. In an extended model – again similar to Xie, et al. (2003) – we include additional measures to control for the presence of board members with a (presumably) superior monitoring technology and/or particular monitoring incentives. Thus, we use the percentage of auditors (*auditor*), the percentage of lawyers (*lawyer*) and the percentage of principal investors (*p_invest*; e.g., private equity or venture capital firms). Moreover, we also include in some of our estimations the percentage of either active or former managing board members of the largest German companies[34] (*afm_board*) as well as the percentage of consultants and academics (*consultant* and *professor*)[35].

Similar to e.g., Burghstahler, et al. (2006) we control for potential sources of variation in our earnings management measure by including in our estimations measures of firm size, firm growth, financing structure, accounting standards, and cross listing at other major stock exchanges. We measure firm size by the natural logarithm of total assets (*log_assets*) while firm growth is equal to the annual percentage change in revenues (*sales_g*). We use *leverage* to control for the financing structure of the firm and to assess the disciplining effect of debt (see Jensen (1986)), which is defined as total debt divided by total assets. We also control for the use of international accounting standards (either IFRS or US GAAP) with a dummy variable that assumes a value of one if the firm uses an international accounting standard and zero otherwise; *inter_acc*)[36]. In addition, we use a dummy variable (denoted *cross_listing*) that

33 We call bank representatives all board members who are listed as "employee of a bank" or have "banker" as their job title in the annual report.

34 These board members are either a member of a management board of one of the largest German companies listed in either the DAX or MDAX index or their company has revenues in excess of EUR 1 billion (in any year of the sample period).

35 The board members were classified according to their job titles and/or job descriptions as displayed in the annual reports of the firms. These classifications are not mutually exclusive, e.g., a lawyer can also be a consultant or a professor.

36 As previous research shows mixed effects of the use of international accounting standards on earnings management (see e.g., Ball, et al. (2003), Barth, et al. (2007)), we hesitate to predict the sign of the coefficient of this variable.

assumes a value of one if the firm is cross-listed either on a major United States stock exchange (NYSE, AMEX, or NASDAQ) or the London Stock exchange[37]. In line with previous research (e.g., Lang, et al. (2006)) we expect less earnings management in companies that are cross-listed in markets that are known for their stronger investor protection. Finally, we include a series of year dummies in our analysis to capture changes over time.

6.5.2. Regression Model

To estimate the effect of gender diversity on earnings management we use the following general model:

$$\begin{aligned} acc\_cfo_{i,t} = {} & \alpha_0 + \alpha_1 perc\_fem_{i,t} + \alpha_2 board\_size_{i,t} + \alpha_3 board\_size2_{i,t} + \alpha_4 \log\_ass_{i,t} \\ & + \alpha_5 sales\_g_{i,t} + \alpha_6 leverage_{i,t} + \alpha_7 bank\_rep_{i,t} + \alpha_8 inter\_acc_{i,t} + \alpha_9 cross\_listing_{i,t} \\ & + year\_dummies_{i,t} + \varepsilon_{i,t} \end{aligned} \quad (2)$$

One of the main advantages of our dataset is that we can observe companies for a relatively long period of time (up to ten years). During this time period many of the firms in our sample experienced considerable changes in the size and the composition of their supervisory boards (particularly with respect to gender diversity). The presence of these companies in our data set allows us to use cluster robust fixed-effects regressions to control for unobserved heterogeneity in the estimations[38]. We would not have been able to use this approach if relevant variables (i.e., female representation and board size) would have been constant over time.

6.6. Results

6.6.1. Female Directors on German Supervisory Boards: Descriptive Evidence

As already mentioned above, the percentage of female directors has increased in large German companies from 7.0% in 1998 to 7.8% in 2007. The share reached its maximum in 2005 with 8.2%, followed by a considerable decline in 2006 when it reached only 7.6% (see Table 18).

37 We do not consider companies listed on the AIM (alternative investment market) as this market has weaker investor protection due to lower admission standards.

38 Cluster fixed effects regressions were used to better deal with extreme values. Additionally, the significance of groups of measures of board composition have been tested yielding similar results (these are available from the authors upon request).

Table 18: Female directors on German corporate supervisory boards

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Average Board Size	10.58	10.00	9.48	9.61	9.78	9.46	9.56	9.44	9.23	9.16
Percent Women on Corporate Boards	7.0%	7.0%	6.7%	7.0%	7.2%	7.7%	8.0%	8.2%	7.6%	7.8%
Average Number of Women on Corporate Boards	0.78	0.74	0.70	0.75	0.80	0.87	0.93	0.94	0.89	0.89
Female Employee Representatives	0.61	0.57	0.55	0.59	0.64	0.71	0.78	0.77	0.71	0.69
Female Union Representatives	0.14	0.11	0.10	0.11	0.12	0.14	0.16	0.14	0.14	0.14
Female Works Council Representatives	0.14	0.15	0.14	0.16	0.17	0.20	0.20	0.22	0.23	0.20
Female Independent Employee Representatives	0.33	0.31	0.30	0.32	0.33	0.37	0.42	0.41	0.36	0.36
Female Shareholder Representatives	0.17	0.16	0.15	0.15	0.16	0.15	0.15	0.17	0.18	0.19
Female Members with PhD	0.07	0.05	0.05	0.06	0.07	0.09	0.09	0.09	0.08	0.08
Share of Female Board Members with PhD	8.7%	7.1%	6.8%	7.9%	9.2%	10.7%	9.5%	9.8%	8.8%	8.5%
Male Members with PhD	3.44	3.09	2.94	2.91	2.88	2.77	2.86	2.86	2.80	2.74
Share of Male Board Members	35%	33%	34%	33%	32%	32%	33%	34%	33%	33%
Connected Female Directors	0.01	0.02	0.02	0.03	0.02	0.02	0.03	0.02	0.05	0.04
Percentage of Firms without Women on the Supervisory Board	51.7%	52.2%	53.9%	53.1%	52.3%	49.6%	45.4%	46.9%	48.8%	49.2%
Percentage of Firms with one Woman on the Supervisory Board	28.0%	28.5%	25.5%	24.4%	23.6%	25.4%	30.3%	27.2%	25.4%	24.4%
Percentage of Firms with two Women on the Supervisory Board	9.2%	9.2%	11.1%	11.8%	10.1%	10.5%	9.7%	10.9%	9.4%	10.1%
Percentage of Firms with more than two Women on the Board	9.2%	8.0%	6.6%	7.7%	10.5%	10.9%	11.3%	11.7%	11.9%	11.8%
Average Size of Supervisory Boards with Female Directors	12.90	12.61	12.58	12.58	12.96	12.73	12.91	12.97	12.95	12.81
Average Size of Supervisory Boards without Female Directors	8.91	8.08	7.51	7.68	7.75	7.06	6.49	6.36	6.53	6.59
Observations	203	244	263	263	249	239	230	231	233	227

It is worth mentioning that almost 80% of all female directors are employee representatives of whom the majority are independent employee representatives, i.e., with no union or works council affiliation. While the average number of female independent employee representatives as well as female union representatives has remained almost constant over the last 10 years, the number of female works council representatives has increased by almost 50% from 1998 until 2007. This most likely reflects the increasing percentage of female works councilors that, in turn, is due the increasing percentage of women in the workforce. Looking at supervisory board members with a PhD it turn out that only 10% of the female board directors, but 33% of their male colleagues hold that kind of an academic degree[39]. What is also worth mentioning is the steep increase in the number of "connected" female directors, i.e., women with three or more further outside board memberships (as listed in the annual reports). This increase is certainly an indicator that the "supply" of female directors is limited and that they remain a scarce resource[40].

While the percentage of boards with no female director remains stable at around 50%, the share of boards with only one female director decreased during our period of investigation (from 28% to 24%). This could be evidence that "tokenism" is decreasing (see also Bourez (2005)) because at the same the percentage of boards with two or more female directors has been steadily increasing. Finally, with regard to board size we observe a widening gap: while boards with female directors have on average 12 to 13 members[41], average size for boards with no female directors decreases from 8.9 to 6.6 members in our sample period. These variations in the percentage of female board directors as well as the variation in board size allow us to use cluster robust fixed-effects regressions (see Table 19 for arrivals and departures of female and male directors as well as for changes in board size). This finding is confirmed when considering the between and within variation as displayed in Table 20: while most variables show larger between variation we still observe considerable within variation.

39 The number of supervisory board members holding a PhDs is again derived from the annual report, where these individuals are usually listed with their titles. Since we are unable to distinguish between "real" and "honorary" doctorates, the different percentage shares of men and women are difficult to explain (the probability of receiving a honorary doctorate increases with age and the female supervisory board members are – on average – younger than their male counterparts).

40 A similar observations has been made by Farrell and Hersch (2005) for the US. They find that 30% of all individuals holding multiple directorships were women.

41 This is mainly due to mandated codetermination, because larger companies usually have larger supervisory boards (in about 25% of all firms the supervisory board is larger – i.e., has more seats - than is required by law).

Table 19: Descriptive statistics on female and male director arrivals and departures and on changes in size

Note: Table 19 provides descriptive statistics on changes in the number of female and male supervisory board members and on changes in supervisory board size for a sample including all German firms listed in the DAX, MDAX, or SDAX during the years 1998 to 2007. Data on female board members and board size were obtained from annual reports.

Female and male director departures / additions	1999	2000	2001	2002	2003	2004	2005	2006	2007	Total
Female Arrivals	24	22	32	34	46	37	29	25	25	274
Male Arrivals	277	316	362	375	402	265	250	275	278	2,800
Female Departures	23	27	21	25	33	36	24	33	29	251
Male Departures	226	300	354	356	444	271	255	282	303	2,791
Net Female Arrivals	1	-5	11	9	13	1	5	-8	-4	23
Net Male Arrivals	51	16	8	19	-42	-6	-5	-7	-25	9
Change in Size of Supervisory Board										
Increase in Size	10	8	12	9	3	6	2	3	3	56
Decrease in Size	2	6	7	4	8	6	2	5	7	47
Total	12	14	19	13	11	12	4	8	10	103
Observations	244	263	263	249	239	230	231	233	227	2,179

Table 20: Overall, between and within variation of main variables

Variable		Mean	Std. Dev.	Min	Max
acc_cfo	overall	6.4	69.64	0.0	2,041.3
	between		25.70	0.0	257.1
	within		64.93	-250.5	1,819.2
acc_sca	overall	0.2	1.58	0.0	58.4
	between		0.67	0.0	9.9
	within		1.46	-9.7	48.7
perc_fem	overall	0.1	0.11	0.0	0.7
	between		0.09	0.0	0.6
	within		0.05	-0.2	0.6
emp_fem	overall	0.1	0.09	0.0	0.5
	between		0.08	0.0	0.3
	within		0.04	-0.2	0.3
share_fem	overall	0.0	0.06	0.0	0.7
	between		0.05	0.0	0.3
	within		0.03	-0.3	0.4
union_fem	overall	0.0	0.03	0.0	0.2
	between		0.02	0.0	0.1
	within		0.01	-0.1	0.1
woco_fem	overall	0.0	0.04	0.0	0.3
	between		0.03	0.0	0.2
	within		0.02	-0.1	0.1
indep_fem	overall	0.0	0.07	0.0	0.5
	between		0.06	0.0	0.3
	within		0.03	-0.2	0.3
board_size	overall	9.9	5.94	3.0	21.0
	between		5.85	3.0	21.0
	within		1.25	0.3	16.3

6.6.2. Univariate Results

Table 21 provides descriptive statistics for the main variables used in our analysis.

Table 21: Descriptive statistics (without year and industry dummies)

Note: Table 21 provides descriptive statistics for the dependent and main independent variables of our model. *Acc_cfo* is the absolute value of accruals scaled by cash flow from operations. Accruals are calculated as follows: (Change in total current assets - change in cash and cash equivalents) - (change in in total current liabilities - change in short term debt) - depreciation. *Acc_sca* is the absolute value of accruals divided by lagged total assets. *Perc_fem* is the share of female directors of total board members, *emp_fem* is the share of female employee representatives, *union_fem* is the share female union representatives, *woco_fem* is the share of female works council representatives, *indep_fem* is the share of independent employee representatives. *Share_fem* is the share of female shareholder rerpresentatives on the board. Connected fem is the share of female board members with 3 or more outside board memberships. *Board_size* is the size of the board, *board_size2* its square. *Log_ass* is the logarithm of total assets, *sales_g* is the annual percentage growth of sales. *Leverage* is defined as short term and long term debt divided by total assets, *bank_rep* is the share of bank representatives of total board members, *inter_acc* is a dummy variable equaling 1 if the firm uses an international accouting standard (either US GAAP or IFRS), *cross_listing* is a dummy variable equaling 1 if the firm is cross listed at a major stock exchange in the UK or US. The sample consists of all German companies listed in the DAX, MDAX, and SDAX for the years 1998 to 2007 with at least two years of available data.

Variable	Mean	St.-dev.	1. Quartile	Median	3. Quartile	Minimum	Maximum
acc_cfo	3.17	9.68	0.30	0.76	1.76	0.00	76.26
acc_sca	0.11	0.14	0.03	0.07	0.13	0.00	0.95
perc_fem	0.08	0.11	0.00	0.00	0.15	0.00	0.67
emp_fem	0.06	0.09	0.00	0.00	0.10	0.00	0.50
union_fem	0.01	0.02	0.00	0.00	0.00	0.00	0.17
woco_fem	0.01	0.04	0.00	0.00	0.00	0.00	0.33
indep_fem	0.03	0.07	0.00	0.00	0.05	0.00	0.50
share_fem	0.02	0.06	0.00	0.00	0.00	0.00	0.67
connected_fem	0.00	0.02	0.00	0.00	0.00	0.00	0.33
board_size	9.94	5.94	6.00	9.00	12.00	3.00	21.00
board_size2	134.14	138.66	36.00	81.00	144.00	9.00	441.00
log_ass	13.57	2.47	11.82	13.20	14.97	3.83	21.42
sales_g	1.30	47.58	-0.03	0.06	0.16	-6.65	2,290.55
leverage	0.27	0.21	0.09	0.24	0.40	0.00	1.71
bank_rep	0.07	0.11	0.00	0.00	0.10	0.00	1.00
inter_acc	0.55	0.50	0.00	1.00	1.00	0.00	1.00
cross_listing	0.12	0.32	0.00	0.00	0.00	0.00	1.00

In Table 22, we present the results of a comparison of firm characteristics for firms that have at least one female director on their supervisory boards and firms that have not a single female director on their boards. The results of the comparison show that firms in years when they have female directors have a significantly larger board (as already mentioned in section 6.1), have significantly higher sales, are significantly larger in terms of total assets and operate in more different sectors (as measured by 2-digit SIC codes). In terms of profitability,

firms with female directors have a higher return on equity (ROE[42]), a smaller return on assets (ROA[43]), and a higher return on invested capital (ROIC[44]). When it comes to market valuation, companies with female directors show a significantly lower valuation as measured by Tobin's Q. The differences in these firm specific characteristics suggest that firms could be influenced by these characteristics when making choices about the gender composition of their boards.

Table 22: Comparison of firms with and without female directors on their supervisory board

This table displays comparisons of means of firm-level characteristics for firm-years in which firms have female directors and firm-years without female directors. ***,**, and * denote statistical significance at the 0.01, 0.05, and 0.10 levels, respectively.

Firm Characteristic	Mean of firm-year-observations with female directors (n=1,141)	Mean of firm-year-observations without female directors (n=1,241)	Difference	
Board Size	12.80	7.32	5.48	***
Sales	8,981,076	3,159,273	5,821,803	***
Log Assets	14.52	12.70	1.82	***
Number of Sectors	5.14	3.82	1.32	***
ROE	5.97	2.88	3.09	*
ROA	0.03	0.12	-0.09	
ROIC	8.44	5.06	3.38	***
Tobin's Q	1.47	1.63	-0.17	**
Risk	4.29	4.15	0.14	

The results of the pairwise Pearson correlation coefficients are displayed in Table 23: As expected we observe a positive and but not significant correlation between our two measures of earnings management (acc_cfo and acc_sca) indicating that acc_sca will be suitable as an additional variable as both variables are conceptually related and with low correlation; acc_sca shows furthermore significantly negative correlation with company size (measured by total assets, log_ass) and is positively correlated with the leverage of the company; additionally, (and already mentioned above), we observe a significantly positive correlation between board size and the percentage of female directors on the supervisory board; this is

42 Calculated as follows: (Net Income before Preferred Dividends - Preferred Dividend Requirement) / Last Year's Common Equity * 100.

43 Calculated as follows: (Net Income before Preferred Dividends - Preferred Dividend Requirement) / Last total assets.

44 Calculated as follows: (Net Income before Preferred Dividends + ((Interest Expense on Debt - Interest Capitalized) * (1-Tax Rate))) / Average of Last Year's and Current Year's (Total Capital + Last Year's Short Term Debt & Current Portion of Long Term Debt).

also holds true for the percentage of female directors and the size of the company. Also notable is the negative correlation between the share of bank representatives and the share of female directors.

Table 23: Pearson correlation

Note: Table 23 provides Pearson correlation coefficients of the main variables used in our estimations. ***,**, and * denote statistical significance at the 0.01, 0.05, and 0.10 levels, respectively.

	acc_cfo	acc_sca	per_fem	board_size	log_ass	sales_g	leverage	bank_rep	inter_acc	cross_listing
acc_cfo	1.00									
acc_sca	0.02	1.00								
per_fem	0.00	-0.04 *	1.00							
board_size	0.01	-0.04 *	0.14 ***	1.00						
log_ass	0.03	-0.06 ***	0.09 ***	0.81 ***	1.00					
sales_g	0.00	0.03	-0.02	-0.03	0.00	1.00				
leverage	0.02	0.05 **	0.04 *	-0.08 ***	0.00	0.03	1.00			
bank_rep	0.00	0.00	-0.06 ***	-0.06 ***	-0.04 *	0.05 **	0.00	1.00		
inter_acc	0.01	0.00	0.03	0.15 ***	0.24 ***	-0.03	-0.05 **	-0.04 *	1.00	
cross_listing	-0.01	-0.02	0.03	0.36 ***	0.49 ***	-0.01	-0.01	-0.02	0.23 ***	1.00

These univariate results give us an idea about the interrelations between the percentage of female directors and earnings management as well as firm and board characteristics. The following multivariate analysis will shed further light on this relationship taking into consideration a wide range of control variables.

6.6.3. Econometric Evidence

6.6.3.1. Gender Diversity, Board Size, and Earnings Management

In a first series of cluster fixed effects regressions, the results of which are displayed in Table 24, we analyze the effect of female board directors on our two measures of earnings measurement. In our first model we observe a statistically significant negative effect of female directors on earnings management, implying that an increase in the percentage of female directors leads to a reduction in accruals and thus earnings management; thus, the addition of a female director to a 20-member board reduces the average level of accruals by 19%. This is in line with our expectations and with prior research (e.g., Adams and Ferreira (2009)). Contrary to our expectations, however, we do not find an effect of board size on earnings management, but instead find a significantly positive effect of sales growth on earnings management; this suggests that firms with higher growth are related to higher levels of earnings management. This might be caused by the efforts of the management of high growth companies to meet their financial targets. Finally, we find that the adoption of international accounting standards (as opposed to German principles) leads to level of accruals and thus higher earnings management. While this might be surprising, Tendeloo and Vanstraelen (2005) find the same effect. They argue that German companies use accruals to manage their earnings instead of building "hidden reserves" once they have adopted international accounting standards (hidden reserves per se are usually not included in accruals, our preferred earnings measure).

Table 24: The impact of board size and gender diversity on earnings management (clustered fixed effects regression)

Note: Models 1-6 provide the results of various clustered fixed effects regressions with two different measures of earnings management: *acc_cfo* (defined as the absolute value of accruals divided by absolute value of operating cash flows) and *acc_sca* (defined as the absolute value of accruals divided by the absolute value of lagged total assets). All models include dummy variables for the year of observation. Standard errors in parentheses. *, **, and *** denote statistical significance at the 0.10, 0.05, and 0.01 levels, respectively.

	(1) acc_cfo	(2) acc_sca	(3) acc_cfo	(4) acc_sca	(5) acc_cfo	(6) acc_sca
perc_fem	-48.75*	-0.0194				
	(28.76)	(0.635)				
emp_fem			-81.11**	-0.152		
			(37.91)	(0.838)		
share_fem			-1.110	0.176	-2.029	0.161
			(46.38)	(1.025)	(46.43)	(1.026)
union_fem					10.13	-0.867
					(101.8)	(2.250)
woco_fem					-12.96	0.150
					(79.84)	(1.765)
indep_fem					-124.2***	0.00274
					(47.99)	(1.061)
board_size	6.029	0.142*	6.610*	0.144*	6.257	0.145*
	(3.875)	(0.0856)	(3.900)	(0.0862)	(3.906)	(0.0863)
board_size2	-0.242	-0.00348	-0.263	-0.00357	-0.258	-0.00358
	(0.165)	(0.00364)	(0.166)	(0.00366)	(0.166)	(0.00366)
log_ass	-0.981	-0.404***	-0.898	-0.404***	-0.862	-0.404***
	(3.562)	(0.0787)	(3.562)	(0.0787)	(3.562)	(0.0787)
sales_g	0.00562	0.000846	0.00629	0.000848	0.00584	0.000850
	(0.0325)	(0.000718)	(0.0325)	(0.000718)	(0.0325)	(0.000719)
leverage	-18.38	0.841***	-17.97	0.842***	-18.10	0.844***
	(12.62)	(0.279)	(12.62)	(0.279)	(12.62)	(0.279)
bank_rep	48.76*	-1.281**	46.36*	-1.290**	45.32	-1.291**
	(28.09)	(0.620)	(28.15)	(0.622)	(28.16)	(0.623)
inter_acc	10.10*	0.204*	10.18*	0.204*	10.04*	0.205*
	(5.199)	(0.115)	(5.199)	(0.115)	(5.200)	(0.115)
cross_listing	-4.212	-0.0478	-4.523	-0.0491	-3.855	-0.0432
	(16.04)	(0.354)	(16.04)	(0.354)	(16.07)	(0.355)
constant	-8.046	4.736***	-11.38	4.723***	-8.983	4.713***
	(48.72)	(1.076)	(48.78)	(1.078)	(48.81)	(1.079)
Observations	2334	2334	2334	2334	2334	2334
R^2	0.013	0.026	0.014	0.026	0.015	0.026

When using our second measure of earnings measurement (*acc_sca*) as dependent variable, we end up with similar results (see model (2) in Table 24). While we again observe a negative effect of female directors on accruals (i.e., less earnings management), this effect is not statistically significant. With regard to board size, we do not find a significant effect; as in model (1) we are not able to confirm the available research (mainly US based) for Germany – suggesting that a smaller board is more efficient in monitoring and thus responsible for a reduction in earnings management. Furthermore, we observe similar significant effects of sales growth and the adoption of international accounting standards on earnings management.

In our third model (model (3)) we take closer look at the impact of various sub-groups of female board directors on earnings management by estimating the separate influence of female employee representatives (*emp_fem*) and female shareholder representatives (*share_fem*). We observe a significant negative effect of both variables with the effect of female employee representatives being twice as strong and with higher statistical significance than female shareholder representatives; this means that the addition of a female employee representative to a 20-member board reduces the level of accruals (and thus earnings management) by 23% vs a 12% reduction with the addition of a female shareholder representative. The findings seem to suggest that the positive monitoring effect, that is realized by female directors, is dominantly induced by the presence of female employee representatives. A possible explanation is that employees often take a more long-term perspective than shareholder representatives, as job security is their main concern and are, therefore, less interested in short-term earnings management. All other effects are similar to the ones obtained in estimations (1) and (2).

Model (4) displays the results of the same regression with our alternative measure of earnings management (*acc_sca*) as the dependent variable. Once again, we do not find a significant effect of the percentage of female board directors, all other effects are similar to the ones in model (2).

Finally, in model (5) we divide the sub-group of female employee representatives even further by distinguishing between female union representatives (*union_fem*), female works council representatives (*woco_fem*) and independent female employee representatives (*indep_fem*). While the observe a similar negative effect of female shareholder representatives on accruals, we see that the negative effect of employee representatives was solely driven by independent female employee representatives; the addition of an independent female employ-

ee representatives reduces average accruals by 35% versus 12% with the addition of a female shareholder representative. Thus, the "female monitoring effect" is mainly driven by female board members, who have neither been appointed by the respective union nor by the firm's works council. The remaining independent variables show the same direction and level of statistical significance as in previous models. The result of our estimation (6) is once again similar to the previous modes with our alternative measure of accruals: we observe the same direction of our variables of female board representation but observe no significance while all other results are in line with prior models.

Summarizing, we confirm our main prediction that a higher percentage of (a specific group of) female board directors is associated with lower levels of accruals and thus less earnings management. Although our results differ marginally between the two different measures of earnings management that we use in our estimations, we are confident of not having produced statistical artifacts, but robust findings on which policy recommendations can (and should) be based.

6.6.3.2. Board Composition, Board Size, and Earnings Management

In a second series of regressions, the results of which are displayed in Table 25, we analyze the effect of board composition on earnings management. Similar to Xie, et al. (2003) we take a closer look at the composition of the supervisory board by occupation and its possible impact on earnings management. Our model (1) reveals that in this context the only statistically significant variable of board composition is the percentage of principal investors: we find a significantly negative effect for the percentage of board members representing the principal investor(s) (*p_invest*). This suggests that principal investors are associated with lower levels of earnings management; this result is in line with Xie, et al. (2003) who find that supervisory board members with a corporate or finance background are associated with less earnings management; in our case the addition of a principal investor to a 20-member board reduces the level of accruals by almost 11%.[45].

Looking at model (2) with our alternative measure of earnings management (*acc_sca*) as the dependent variable, we end up with different results: While the coefficient of the percentage of principal investors does not retain its level of statistical significance, we now find a

45 Again, the coefficients of the remaining variables are in line with our expectations with effects that are similar to the ones documented in our first set of regressions already.

significant positive impact with the percentage of auditors. This is rather counterintuitive and suggests that more auditors are associated with more earnings management (we expected to find the opposite, i.e., a negative effect); the addition of an auditor to a 20-member board increases the level of average accruals by 9%. One possible explanation is that auditors as experts in accounting rules are also specialists in the use of accounting discretion. With regard to board size we once again do not find any significant effect[46].

Overall, we can only partly confirm prior research (Xie, et al. (2003)) finding that supervisory board members with a corporate or finance background are associated with less earnings management. In the German context this is at best true for certain sub-groups (like principal investors) but can certainly not be generalized as we also observe more earnings management with a higher percentage of auditors on the supervisory board.

46 The remaining variables have similar effects as the ones we observe in our first series of regressions.

Table 25: The impact of board size and board composition on earnings management (clustered fixed effects regression)

Note: Models 1 and 2 provide the results of clustered fixed-effects regressions with two different measures of earnings management: *acc_cfo* (defined as the absolute value of accruals divided by absolute value of operating cash flows) and *acc_sca* (defined as the absolute value of accruals divided by the absolute value of lagged total assets). All models include dummy variables for the year of observation. Standard errors are in parentheses. *, **, and *** denote statistical significance at the 0.10, 0.05, and 0.01 levels, respectively.

	(1) accruals_cfo	(2) accruals_scaled
auditor	4.821	0.204*
	(4.679)	(0.107)
lawyer	-4.561	0.0357
	(3.872)	(0.0586)
p_invest	-6.732**	0.0953
	(3.268)	(0.106)
board_large	1.910	-0.00168
	(3.917)	(0.0473)
consultant	-1.235	0.0731
	(5.139)	(0.0548)
professor	-2.398	-0.0508
	(7.349)	(0.115)
board_size	-0.555	0.00649
	(0.799)	(0.0128)
board_size2	0.0286	-0.000228
	(0.0391)	(0.000437)
log_ass	-0.614	-0.00137
	(0.596)	(0.0140)
sales_g	0.00181**	0.000250***
	(0.000833)	(3.41e-05)
leverage	2.369	-0.0186
	(2.565)	(0.0299)
bank_rep	0.686	-0.0878
	(4.277)	(0.0643)
inter_acc	2.191***	0.0332***
	(0.654)	(0.00948)
cross_listing	-2.753	-0.0178
	(2.159)	(0.0450)
constant	11.24	0.118
	(8.032)	(0.193)
Observations	2,334	2,334
R^2	0.018	0.043

6.7. Conclusion

Using the by far largest and most comprehensive dataset on German supervisory boards we find that female board members contribute to "good governance" i.e., are better monitors inducing less earnings management. More specifically, this result is mainly driven by the percentage of independent employee representatives and female shareholder representatives. The perhaps most important implication is, therefore, that the evidence presented above cannot be used to advocate quota-based policy initiatives as it is not the quantity of female directors per se that improves the quality of monitoring leading to less earnings management. Apparently, it is the independence and the long-term perspective of a specific sub-group of employee representatives that turns out to be the most important driver for good governance and diligent monitoring. The size of this sub-group, however, can not (and should not) be regulated by law.

With regard to board size, we do not find any evidence that small boards are more efficient monitoring in the sense that they are associated with lower levels of earnings management. These findings do not support recent interventions to reduce the size of German supervisory boards. This is in line with prior research (see e.g., Coles, et al. (2008)) who also can not show consistent positive effects of smaller boards but rather demonstrate that larger boards are beneficial in certain industries and/or under specific conditions (complex industries, diversified firms, etc.).

Finally, the same holds for other variables of board composition where we are not able to find consistent results for specific groups of board members as set forth in prior research by e.g., Xie, et al. (2003).

7. Cash Holdings, Board Size and Composition: Empirical Evidence from Germany

7.1. Introduction

"*Conflicts of interest between shareholders and managers over payout policies are especially severe when the organization generates substantial free cash flow"* (Jensen (1986), p. 323)

One of the central questions of agency theory is the one of the use of internal funds (cash) as part of the free cash flow hypothesis (Jensen (1986), Stulz (1990)): managers must take strategic decisions on whether to spend the funds internally, i.e., by investing in fixed assets (capital expenditures) or in intangible assets (research and development), spend funds externally for acquisitions, or disgorge cash to shareholders, either via dividends or share repurchases.

Thus, cash holdings and the associated agency problems have been discussed extensively in academia. Only in recent years though the debate has been extended to include explicit corporate governance measures as ways to mitigate this conflict: "*Good corporate governance is the shareholders' defense against inefficient use of corporate assets by managers*" (Dittmar and Mahrt-Smith (2007), p. 600). This string of research has mainly focused on the Anglo-American one tier board system and has not considered the board composition in detail. I expect that this detail of board composition will give me more insight on what really matters in corporate governance with regards to boards. While research on firm-level governance in the US mainly focuses on management and family control rights, as prior research (e.g., Kalcheva and Lins (2007)) assumes, that this group is responsible for operational and financial decisions, I – for the first time – focus on measures of board composition which give a more detailed picture of firm-level corporate governance for German firms. I perform this analysis using a comprehensive data set of the largest German listed companies for the period from 1998 until 2007, considering the effects of board size and board composition on the level of cash holdings. The main result is that employee representation is associated with lower levels of cash holdings; independent employee representatives mainly drive this result. While I find that larger boards are associated with lower levels of cash holdings, I am not able to find stringent results with regards to other measures of board composition.

Furthermore, I enhance shortcomings of country-level studies (e.g., Dittmar, et al. (2003), Kalcheva and Lins (2007)) that do not consider country-specific constellations such as codetermination in Germany which – as indicated in prior research – is considered to lead to lower shareholder power in certain cases. Additionally, I also provide more up to date evidence as international studies were mainly based on data from 1996 and earlier; significant development has occurred since then, i.e., improvements in corporate governance and transparency in Western Europe and Germany (e.g., introduction of German corporate Governance Code in 2002), that was not covered by prior research.

Finally, Germany provides an excellent ground for this analysis, as shareholder protection is considered to be rather weak and thus shareholders might not be able to force management to disgorge excess cash to them; such shareholder power is assumed in countries like the US where shareholder protection is considered as strong (see La Porta, et al. (2000)). Such lower shareholder protection would make it even more important to have good monitors in place.

The remainder of the paper is organized as follows. Section 7.2 presents a review of existing literature on board diversity and earnings management, and section 7.3 describes the legal background in Germany. Section 7.4 discusses the data, the empirical methodology employed is explained in section 7.5. The results are displayed in section 7.6, section 7. 7 concludes the paper.

7.2. Cash Holdings and Corporate Governance

7.2.1. Optimal Levels of Cash Holdings and Agency Theory

Early research on cash holdings aimed on finding the optimal level of cash in a firm – from a firm perspective. Ideally, the level of cash is such that "*the marginal benefit of cash holdings equals the marginal cost of those holdings*" (Opler, et al. (1999), p. 4). As costs for holding cash are generally seen the lower rates of return versus other asset classes and possible tax disadvantages. The motives of cash holdings were already describes by Keynes (1936) and pointedly summarized by Opler, et al. (1999): “First, the transaction cost motive building on the fact that the firm saves transaction costs when it does not have to externally raise funds or liquidate assets, and second, the precautionary motive, which stands for the possibility of

firms to use cash holdings to finance investments and activities in case outside funding is not available or costly."

While a lot of further research focused on finding the optimal level of cash holdings considering the above mentioned trade-offs (e.g., Mulligan (1997), Miller and Orr (1966)), a level optimal in terms of shareholder wealth maximization, this does not consider any conflicts between shareholders and managers: "*The problem is how to motivate managers to disgorge the cash rather than investing it at below the cost of capital or wasting it on organization inefficiencies*" (Jensen (1986), p. 323)

The conflicts between shareholders and managers associated with cash flow and cash holdings have received a great deal of discussion in agency theory. Generally, payouts to shareholders reduce the power of managers as available resources under their control are reduced. If these resources are not readily available anymore, managers have to raise outside capital and thus receive increased monitoring by the capital markets (Jensen (1986)). As Jensen (1986) points out that there are numerous incentives for managers to have relatively high cash holdings as this enables them to grow their companies (even beyond optimal size) to increase their power and potentially even compensation (when dependent on sales or sales growth).

Jensen (1986) additionally mentions that a way to mitigate these principle agent conflicts is debt as it is effectively reduces the conflict between shareholders and managers; if managers take on debt to repurchase shares they make a credible promise to shareholders to pay out future cash flow. This is specifically true for companies with high free cash flow (defined as cash flow in excess of what is required to fund all investments that are value creating) and low growth prospects. The author provides evidence for this as he observes that share prices increase following an increase in leverage and decrease when leverage is reduced and thus more cash available for managers. Jensen furthermore states that the same applies to leveraged buyouts as he argues that many of the benefits of leveraged buyouts are due to the control function of debt.

Stulz (1990) builds on this and argues that in general financing policy matters to reduce agency cost of managerial discretion. He sees two different agency costs which arise due to managerial discretion: first, overinvestment cost which is caused by too much investment, i.e.,

investment in non-value creating projects, and second, underinvestment cost which is caused by a lack of credibility of management when arguing that it can not fund value-creating projects with the current cash flow. Therefore, Stulz argues that there is a unique solution for each firm's capital structure. This is also true with regards to timing of financing decisions, as he argues that cash flow volatility should be low in order to have foreseeable funds to engage in value-creating investments.

Building on the research of optimal cash holdings and agency theory, Opler, et al. (1999) show, based on a sample of all publicly traded US firms from the period 1971 to 1994 (n=87,117), that, on the one hand, firms with strong growth opportunities, firms operating riskier businesses, and small firms have higher cash holdings; on the other hand, firms with better access to capital markets, i.e., large firms or firms with credit ratings, have lower cash holdings. This supports the view that managers hoard cash if they have the chance to do so out of precautionary motives. Furthermore, the authors do not find evidence that excess cash has a significant impact on dividends or repurchases, capital expenditures, and acquisition spending in the short run.

Any research about corporate governance with regards to cash holdings should address the above mentioned conflicts; thus, I consider next the existing research in the field of corporate governance and cash holdings.

7.2.2. Cash Holdings and Corporate Governance

While earlier research on cash holdings has mainly considered one measure of governance, insider ownership (e.g., Jensen and Meckling (1976), Harford (1999)), first attempts to include further corporate governance measures were performed on an international level: by comparing the levels of cash holdings across several countries Dittmar, et al. (2003) find, based on a sample of some 11,000 companies from 45 countries for the year 1998 (n=11,414), strong effects of corporate governance on cash holdings: even after controlling for industry effects and firm characteristics, the authors find that firms in countries with the lowest level of shareholder protection have cash holdings which are more than 100% larger than the holdings of firms in countries with the highest level of shareholder protection. To measure shareholder protection the authors use a shareholder rights measure developed by La Porta, et al. (1998); this measure evaluates the strength of minority shareholders in corporate governance.

Pinkowitz, et al. (2006) extent this research as they consider the impact of cash holdings on firm value using time series data for the period of 1988 to 1998 from 35 countries. They find that minority shareholders value cash holdings less for firms that incorporate in countries with lower shareholder rights and that they value dividends more for firms in such countries compared to firms in high protection countries.

Kalcheva and Lins (2007) further build on this as they consider the benefits and costs of cash holdings on an international level. Based on a sample of 5,102 firms from 31 countries for the year 1996 (n=5,102) the authors consider country-level and firm-level corporate governance; their measure of managerial entrenchment, i.e., firm level corporate governance, is the share of control rights available to the management group and their families and the existence of possible other strong blockholders. The authors find that agency problems and high cash holdings are negatively related to firm value; this finding is independent of country-level shareholder protection.

Faulklender and Wang (2006) examine the marginal value of cash holdings on a firm-level for US companies in relation with governance-related measures: based on a sample of US companies from 1971 to 2001 (n=82,187) they find that the marginal value of cash is lower with higher cash levels, higher leverage, better access to capital markets as well as for firms that disgorge cash via dividends rather than share repurchases.

Dittmar and Mahrt-Smith (2007) take a more detailed look on firm-level corporate governance and cash holdings and its impact on valuation on a national level, i.e., the US. Using a sample of all US publicly traded firms for the years 1990 to 2003 with 1,952 firms and 13,095 observations, the authors find that the value of an additional Dollar of cash is worth between $0.42 and $0.88 in a poorly governed firm and that this value doubles for firm with "good" governance, which is evaluated with multiple measures based on managerial entrenchment and on the existence of takeover defenses as well as the monitoring effect of large shareholders.

Harford, et al. (2008) build on this and use multiple measures of corporate governance (i.e., ownership concentration (managerial and institutional), executive compensation, board composition, and an index of shareholder rights as developed by Gompers, et al. (2003)) and thus agency problems for US firms. Based on a sample of 11,645 firm-year observations of

1,872 firms for the years 1993 to 2004, the authors observe that firms with higher ownership concentration, especially insider ownership, have higher cash holdings, while firms with weaker shareholder rights have lower cash holdings. These firms with weaker shareholder rights with higher cash holdings spend less cash on research and development (R&D) and spend more on capital expenditures (capex) as well as acquisitions. With regards to distributions to shareholders, weaker shareholder rights firms prefer repurchases in order to avoid future commitments with regards to payouts to shareholders. The opposite is true for firms with stronger shareholder rights; these prefer to increase dividends, thereby committing higher payouts in the long term.

Klasa, et al. (2009) consider cash holdings from a different perspective: based on a sample with 34,042 observations of US manufacturing firms from 1983 to 2004, they find that firms, which operate in highly unionized industries, hold less cash in order to strengthen their bargaining position in negotiations with unions. With this perspective they introduce another cost of holding large cash reserves – the weakened position in negotiations with unions.

Considering the severity of agency problems, Chi and Scott Lee (2010) find, based on a sample of US companies from 1990 to 2005 (n=17,222) that higher quality of corporate governance has a positive effect on firm value for firms that have high free cash flow. On the contrary, they find that lower or no impact of governance for firms with low free cash flow. In their research, free cash flow is taken as a proxy for agency conflicts. Furthermore, the authors find that board size and board independence has a negative effect on firm value for companies with more severe agency problems (i.e., higher free cash flow); however, this finding does not hold when controlling for other governance mechanisms.

Ferreira and Vilela (2004) provide evidence about cash holdings on a European level (using data from EMU companies from 1987 to 2000 with 6,387 observations): they find that both investment opportunities and cash flows have a positive effect on cash holdings, while asset liquidity, leverage, size, bank debt have a negative impact. Furthermore, they also find that stronger investor protection and concentrated ownership also leads to lower cash levels as well as capital markets development. Schauten, et al. (2008) consider the value of excess cash of large European firms. Based on a sample of 271 large European firms from 1990 to 2005 (n=3,831) they find that, out of a range of governance variables considering shareholder

rights, takeover defenses, disclosure and board functioning, only takeover defenses have a significant and positive effect on the value of excess cash. In addition, they find that poorly governed firms spend excess cash more quickly resulting in negative effects on their operating performance.

Ozkan and Ozkan (2004) provide research for Europe on a country-level as they consider the UK market with a sample of 1,029 UK firms from 1984 to 1999 with 12,960 observations. They find that managerial ownership has a non-monotonic effect on cash holdings; cash holdings fall as managerial ownership increases to 24%, it rises as it increases to 64%, and falls again at higher ownership levels. While they do not find any effect of board composition and the presence of ultimate controllers, they observe that family-controlled companies tend to have higher levels of cash holdings. Furthermore, they find that growth opportunities, cash flows, liquid assets, and bank debt have significant effects on cash holdings.

With regards to the German market I was not able to find any prior research on cash holdings and corporate governance. Thus, I want to fill this gap with my study and also provide more detail on the effects of more granular measures of board composition. This is especially motivated by the unique environment present in the German market which I explain in more detail in section 7.3.

7.2.3. Research Hypotheses

Based on prior research I have two broad hypotheses with regards to the level of cash holdings and my measures of board size and board composition. I generally expect a negative relationship between board size and cash holdings as I assume that larger boards are more effective monitors with regards to the rather complex area of cash holdings, which requires - in my perspective - more expertise that is more likely to be prevalent in large boards; this is a result found in prior research by Coles, et al. (2008) as they point out that larger boards are more effective for more complex tasks. Thus my first hypothesis is:

Hypothesis 1: Firms with larger boards are more effectively monitored and thus have lower levels of cash holdings.

With regards to board composition, I generally expect the same relationship as I assume lower cash holdings with better governance.

Hypothesis 2: Firms with better governance, caused by certain characteristics of board composition, have lower levels of cash holdings.

I break this main hypothesis down on board composition in several sub-hypotheses: Considering employee representation I expect lower levels of cash holdings; however, this could be driven by two reasons (as laid out by above mentioned prior reseach): first, employee representatives are more independent from management and have high operational knowledge and thus might be more diligent monitors. Second, lower levels of cash could be driven by the managements desire to have lower levels as an argument when negotiating with unions. Thus, my first sub-hypothesis is:

Hypothesis 2a: Firms with employee representation have lower levels of cash.

With regards to further measures of board composition (the share of bank representatives, former managing board members, auditors, and lawyers) I expect, along the main hypothesis 2 that better monitoring of these members will lead to lower levels of cash and higher valuations; I do not establish a sub-hypothesis for each of these variables.

Finally, regarding female representation on the board I expect - along the lines of prior research (see section 5.2.2 for a comprehensive overview of existing research) - better monitoring of female members and thus lower levels of cash.

Hypothesis 2b: Firms with female directors have lower levels of cash.

7.3. Legal and Institutional Background

The German system of corporate governance differs fundamentally from the Anglo-American one: while the latter has the main goal to maximize the return to the shareholder and thus provide an efficient system to mitigate any agency problems (Shleifer and Vishny (1997)), the German system tries to take all stakeholders into account and to include their varying views in its corporate decision making (Fauver and Fuerst (2006)). More specifically, a publicly held German company (*Aktiengesellschaft*) is governed by a two-tiered board structure, consisting of the management board (*Vorstand*) and the supervisory board (*Aufsichtrat*). The management board consists of the executive directors and is responsible for running the firm on a day-to-day basis and setting its strategic direction. The supervisory board has, to a

large extent, similar duties as the US board of directors as it is responsible for the remuneration of the management board and the appointment of its members. However, the fundamental difference is that the management board reports to the supervisory board and no management board member can be a simultaneous member of the supervisory board.

Generally, the law for stock corporations (*Aktiengesetz*) sets the size of the supervisory board – with a minimum size of 3 and a maximum of 21 depending on statutory equity capital. Furthermore, a set codetermination laws determines the size and composition of the supervisory board of nearly all[47] private limited liability corporations (GmbH) and publicly listed companies (Aktiengesellschaft): The *Montanmitbestimmungsgesetz* of 1951 requires that companies with more than 1,000 employees operating in the steel, mining and coal sector are subject to a 50% employee and 50% shareholder representation on the supervisory board (one-half or parity codetermination). Depending on the statutory equity capital of the company and the number of its employees, the size of the board is set to 11, 15 or 21, always including one "neutral" member, i.e., a member that is neither a representative of the employees nor of the shareholders. For boards with 15 and 21 members, respectively two or three union members are part of the employee representatives; the remaining employee representatives can either be part of the so called works council, a form of employee representation on the shop floor or a representative independent of unions or works councils. The *Montanmitbestimmungsgesetz* was extended to companies from all other industries in 1976 with the *Mitbestimmungsgesetz*, which sets the size of the board and its composition for public companies with more than 2,000 domestic employees. This requires companies fitting these specifications to give half of their board seats to employee representatives. The chair of the board, which has two votes in a tied situation, remains a shareholder representative. Thus, this form of codetermination is called "quasi-parity" codetermination. To simplify the discussion, I will also call this form of codetermination “parity” or “one-half” codetermination as research has shown that most decisions are made in unison and the chairman rarely uses his two votes to outvote the employee representatives (Kommision Mitbestimmung (1998)). Depending on the number of employees the size of the board is set to 12, 16, or 20 members for companies with domestic employees between 2,000 and 10,000, 10,000 and 20,000 and more than 20,000 respectively. Furthermore, union representation as part of this employee representation is set

47 All companies which primary business is in the field of media or religious, union or political activities are not subject to these codetermination laws.

to two or three members depending on the size of the board. One of the employee representatives must be from the middle management (*leitender Angestellter*). Finally, all public companies, except those which are family-owned, with 500 to 2,000 employees are subject to the *Drittelbeteiligungsgesetz* of 2004 which requires these companies to have at least one-third of their board seats filled with employee representatives.

7.4. Data

7.4.1. Sample Formation

My data consists of all publicly listed German companies that were listed for at least one year in one of the three largest German stock market indices - DAX, MDAX, or SDAX – during the period 1998-2007. Furthermore, only those companies with at least two years of available data were included in the dataset. As I was not able to obtain annual reports for one or more years for seven companies, the initial sample consists of 2,476 observations from 306 companies. From this initial sample I drop all companies that are incorporated as *Kommanditgesellschaft auf Aktien* (KGaA), as this is a hybrid organizational form between a partnership and a stock corporation, and all foreign companies as these are not subject to the German law. Finally, I exclude all firms that operate in the financial industry (SIC codes 6000 to 6999) as inventories include marketable securities and thus liquidity is hard to assess. This leaves me with 1,904 observations from 231 firms in my final dataset.

7.4.2. Data Sources

All data on supervisory board composition is hand-collected from annual reports. Reports not available from the company's website were obtained from the annual report database of the *Schutzgemeinschaft der Kapitalanleger e.V.* as well as various archives in Germany (Archive of the Bavarian Chamber of Commerce, Archive of the University of Bremen, Archive of the University of Cologne). Finally, if no reports were available, data for supervisory board composition was culled from the *Hoppenstedt Jahrbuch der Großunternehmen*. Measures of accounting performance as well as business and geographic segment data were obtained from Thomson Reuters Worldscope. Missing accounting data in Worldscope was complemented with data from annual reports. I obtained data on market capitalization from Datastream. Finally, I added data for special company conditions (restructurings, mergers & acquisitions) from an extensive press search.

7.5. Methodology

7.5.1. Variables

My analysis comprises a series of cross-sectional multivariate regressions to determine the impact of board size and board composition on the level of cash. To ensure the robustness of my results I use scale cash by different measures, which I assume to be complementary to each other and measure essentially the same.

Similar to Harford, et al. (2008) I regard cash holdings as an important part of the operations of the firm as it is, at least partly, a component of working capital of the firm. As working capital is usually regarded in a close relationship to sales, I scale cash holdings[48] by sales as my measure of cash holdings (*cash_sales*). Furthermore, I alternatively use cash divided by net assets[49] (*cash_net_assets*) as well as an industry-adjusted measure of cash to sales (*industry_adj_cash*) as used in prior research (e.g., Opler, et al. (1999), Harford, et al. (2008)). The industry-adjusted measure is considered as I believe that the industry has a significant effect on the required level of cash. This measure is derived as follows: I first calculate the mean levels of cash holdings to sales for each of the one-digit SIC industries and then calculate each firm's value by subtracting the respective industry mean from the firm-specific cash holding.

As measures of firm specific governance I use board size and several variables indicating the composition of the supervisory board. I measure board size with the variable *size,* which indicates the absolute number of board members. An overview of the development of the average board size in Germany is provided in Table 26. Prior evidence on the effect of board size is mixed: while e.g., Jensen (1993) and Yermack (1996) believe that smaller boards can reach agreements more efficiently and thus are better in monitoring, Harris and Raviv (2006) find that large boards will provide better monitoring for firms which provide ample opportunities to managers for private consumption. While literature on the German market (section 5 and 6) is not able to find consistent effects of board size with regards to more efficient monitoring, I still expect a negative effect of board size on cash holdings (as also established in my research hypotheses) as I believe that larger boards are more capable in monitoring on rather complex area of cash holdings.

48 Defined as cash and cash equivalents as in prior research (e.g., Harford, et al. (2008), Dittmar and Mahrt-Smith (2007))

49 Total assets minus cash and cash equivalents

When considering board composition I consider first the general impact of the share of employee representation (measured by the variable *emp_rep*, which indicates the share of employee representatives over total board members). With regard to the effect of employee representation on cash levels I expect a positive effect; prior research (e.g., Gorton and Schmid (2004) and Klasa, et al. (2009)) finds that companies increase leverage to decrease cash holding in order to improve their bargaining position with labor unions. Thus, with employee representation on the supervisory board I expect a contrary effect, i.e., that I observe higher cash levels with more employee representatives on the board. To research further details of employee representation I consider its components as the representatives are either union representatives, works council representatives, or independent representatives (as mentioned in section 7.3). Thus, I measure with the variables *union_rep*, *woco_rep*, and *ind_rep* the respective shares of these representatives of total board members. I expect a similar effect as my main variable *emp_rep*.

Furthermore, I consider variables of board composition on the shareholder representatives' side as the annual report mentions the job title for shareholder representatives; I research the specific effect of the following groups: former managing board members, bank representatives, auditors, and lawyers. I measure the share of former managing board members of total board members with the variable *former_bm*; on average 6% of shareholder representatives on the supervisory board are former managing board members. I can imagine two different effects of this measure: first, a positive effect would be likely if former board members use their insider knowledge to be very diligent monitors and knowledgeable advisors. Conversely, if they are primarily interested in their reputation (i.e., they desire their own work as management board members be regarded positively or they try to cover mistakes from the past and thus want to have as much cash reserves as possible to absorb the effects of mistakes) or in their power as supervisory board members (i.e., grow the company with NPV-negative projects), I expect a negative effect of the share of former board members on cash holdings as they might neglect their duties as thorough monitors and valuable advisors.

The share of bank representatives is measured by *bank_rep* (on average 9.4% of shareholder representatives are bank representatives); with regards to its effect on cash holdings I expect a positive of bank representatives as I assume – in line with prior research (e.g., Dittmann, et al. (2010)) that bankers want firms to meet their interest payments and debt cov-

enants and thus keep higher levels of cash out of a precautionary motive. *Auditor* measures the share of auditors and *lawyer* the share of lawyers. These board members were classified as listed with their job descriptions in the annual reports of the firm. These classifications are not mutually exclusive, e.g., a lawyer could also an auditor or a former board member. I am not able to predict the effect of either of these variables as I could imagine lower cash holdings due to better monitoring in terms of efficiency as well as higher cash holdings out of a transaction or precautionary motive.

Finally, I regard the effect of female board members by using several variables: first, I measure the general share of female directors with *female*; second, I regard details of female representatives: *union_female* measures the share female union representatives, *works_female* works council representatives, *ind_female* independent female employee representatives and *shareholder_female* female shareholder representatives. I expect lower cash levels with female board members as Adams and Ferreira (2009) find that "*gender-diverse boards allocate more effort to monitoring*". This effect could be limited to a certain "amount" of gender diversity though as also Adams and Ferreira (2009) suggest that too much gender diversity could lead to "overmonitoring". My prediction with regards to the effect of female board representation on cash holdings is generally positive as observed in previous research (e.g., Catalyst (2007), section 5 and 6). The share of female board members is on average 8.1.% - a detailed breakdown of female directors and its development in German supervisory boards is shown in Table 26.

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Table 26: Development of female directors in German corporate supervisory boards

Note: This includes boards of all German listed companies, except foreign companies and KGaAs and financial services firms

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Board size	10.58	10	9.48	9.61	9.78	9.46	9.56	9.44	9.23	9.16
Percent women on the board	7.00%	7.00%	6.70%	7.00%	7.20%	7.70%	8.00%	8.20%	7.60%	7.80%
Average number of women on the board	0.78	0.74	0.7	0.75	0.8	0.87	0.93	0.94	0.89	0.89
Female employee representatives	0.61	0.57	0.55	0.59	0.64	0.71	0.78	0.77	0.71	0.69
Female union representatives	0.14	0.11	0.1	0.11	0.12	0.14	0.16	0.14	0.14	0.14
Female works council representatives	0.14	0.15	0.14	0.16	0.17	0.2	0.2	0.22	0.23	0.2
Female independent employee representatives	0.33	0.31	0.3	0.32	0.33	0.37	0.42	0.41	0.36	0.36
Female shareholder representatives	0.17	0.16	0.15	0.15	0.16	0.15	0.15	0.17	0.18	0.19
Female members with PhD	0.07	0.05	0.05	0.06	0.07	0.09	0.09	0.09	0.08	0.08
share of female board members	9%	7%	7%	8%	9%	11%	10%	10%	9%	9%
Male members with PhD	3.44	3.09	2.94	2.91	2.88	2.77	2.86	2.86	2.8	2.74
share of male board members	35%	33%	34%	33%	32%	32%	33%	34%	33%	33%
Connected female directors	0.01	0.02	0.02	0.03	0.02	0.02	0.03	0.02	0.05	0.04
Percentage of firms with no women on the board	51.7%	52.2%	53.9%	53.1%	52.3%	49.6%	45.4%	46.9%	48.8%	49.2%
Percentage of firms with one woman on the board	28.0%	28.5%	25.5%	24.4%	23.6%	25.4%	30.3%	27.2%	25.4%	24.4%
Percentage of firms with two women on the board	9.2%	9.2%	11.1%	11.8%	10.1%	10.5%	9.7%	10.9%	9.4%	10.1%
Percentage of firms with more than two women on the board	9.2%	8.0%	6.6%	7.7%	10.5%	10.9%	11.3%	11.7%	11.9%	11.8%
Average size of board with female director	12.9	12.61	12.58	12.58	12.96	12.73	12.91	12.97	12.95	12.81
Average size of board with no female director	8.91	8.08	7.51	7.68	7.75	7.06	6.49	6.36	6.53	6.59
Observations	203	244	263	263	249	239	230	231	233	227

As firm-level control variables I use variables similar to Harford, et al. (2008) and Opler, et al. (1999) when analyzing the level of cash holdings: first, I use the logarithm of assets (*log_assets*) as a proxy for firm size, generally also considered as a takeover deterrent. *Leverage* measures the firm-specific leverage (short-term and long-term debt divided by total assets); debt plays an important role when determining the level of liquid assets: first, information asymmetries might make it difficult and expensive for firms to raise debt and thus these companies prefer to hold liquid assets or reduce investments to avoid costs of financial distress (Myers and Majluf (1984)); second, agency costs of debt emerge when the interests of shareholders differ from those of the debtholders making it very expensive to raise additional funds which might lead to asset substitution and underinvestment (Jensen and Meckling (1976)). Tobin's Q (*tobin_q*[50]) is used, similar to the market-to-book ratio, as a proxy for profitable investment opportunities (Opler, et al. (1999)); I would expect firms with a high Tobin's Q to have higher cash holdings as the cost of not investing in profitable projects is high. The ratio of cash flow to assets (*cash_flow_na*), calculated as earnings after interest, dividends and taxes but before depreciation divided by net assets, is an important factor in determining the

50 Calculated as follows: $Tobin'sQ = \frac{Market\ value\ of\ equity + Book\ value\ of\ assets - Book\ value\ of\ equity}{Book\ value\ of\ assets}$

level of cash and also as a measure of the severity of agency problems (as measured by free cash flow by Chi and Scott Lee (2010)). Furthermore, as a risk proxy, the standard deviation of free cash flows[51] in the past 10 years is considered (*free_cf_stdev*). Also similar to Opler, et al. (1999) I use the ratio of net working capital to net assets[52] (*net_wc_na*) to measure liquid asset substitutes which e.g., exist due to factoring of receivables. The ratio of research and development expenses to sales (*r_d_sales*) is taken as a proxy for the cost of financial distress because R&D expenses are an investment where information asymmetries play an important role; thus, I expect higher cost of financial distress for firms with higher R&D expenses (see Opler, et al. (1999) and Opler and Titman (1994)). As a proxy for expansive investment of management the ratio of capital expenditures to sales (*capex_sales*) is used, similar to Harford, et al. (2008).

Furthermore, to control for cross-listings I use a dummy variable *cross_listing* which assumes one if the firm is cross-listed either on a United States stock exchange (NYSE, AMEX, or NASDAQ) or the London Stock exchange[53]; as in prior research (Frésard and Salva (2009)), I expect that being cross-listed will reduce the risk of insiders using cash holdings for private benefits due to higher shareholder protection at the stock exchanges where the firms cross-list. With my variable *dividend_paid* I include a dummy variable that assumes the value of one if the company paid a dividend in the respective year. In addition, I consider ownership with the cumulative share of employee ownership (*emp_held*) and institutional ownership (*invest_held*)[54]. I control for ownership as prior research on cash holdings for international markets (e.g., Opler, et al. (1999)) as well as the German market (e.g., Gorton and Schmid (2004); Gugler and Yurtoglu (2003)) has shown the importance of insider and institutional ownership on cash holdings. Finally, assuming that cash holdings are specific to time periods, I control for the time period with year dummies.

7.5.2. Econometric Methodology

In my analysis I estimate the effect of board size and board composition on the level of cash holdings using the following general model:

51 Calculated as funds from operations minus capital expenditures minus cash dividends paid
52 Current assets (net of cash and equivalents) minus current liabilities divided by net assets
53 I do not consider companies listed on the UK AIM (alternative investment market) as this market has weaker investor protection due to lower admission standards.
54 Due to the lower availability including these variables slightly reduces the number of observations made.

$$cash\_sales_{i,t} = \alpha_0 + \alpha_1 size_{i,t} + \alpha_2 union\_rep_{i,t} + \alpha_3 woco\_rep_{i,t} + \alpha_4 ind\_rep_{i,t} + \alpha_5 \log\_ass_{i,t} + \alpha_6 leverage_{i,t} + \alpha_7 tobin\_q_{i,t} + \alpha_8 cash\_flow\_na_{i,t} + \alpha_9 free\_cf\_stdev_{i,t} + \alpha_{10} net\_wc\_na_{i,t} + \alpha_{11} r\_d\_sales_{i,t} + \alpha_{12} capex\_sales_{i,t} + \alpha_{13} cross\_list_{i,t} + \alpha_{14} dividend\_paid_{i,t} + \alpha_{15} emp\_held_{i,t} + \alpha_{16} invest\_held_{i,t} + year\_dummies + \varepsilon_{i,t} \quad (1)$$

One of the big advantages of my dataset is that I can observe companies in my dataset for a relatively long period of time (up to ten years). During this time period many of the firms show changes in the characteristics relevant to board size and board composition (see Table 27 and Table 28). These companies are of particular interest to my research as changes in their board characteristics allow me to use firm fixed-effects regressions to control for un-observed heterogeneity[55]. I would not have been able to use this approach if relevant variables would have been constant over time.

7.6. Results

7.6.1. Supervisory Boards and Cash Holdings in Germany

Table 27 provides an overview on the development of board size and board composition of the largest German listed non-financial companies in the years from 1998 to 2007: while the average board size has decreased from 10.7 members in 1998 to 9.8 members in 2007, the average number of employee representatives on boards has also decreased from 4.7 to 4.0 in this time period. With regards to shareholder representatives on German supervisory boards the most significant change happened to the number of bank representatives: while in 1998 almost one bank representative was part of the supervisory board its number has reduced by one third to 0.6 average members in 2007.

55 An estimation using a clustered fixed effects estimation to control for extreme values yields similar results with slightly less statistical significance for the variables of board size and composition; the significance of groups of measures of board composition has also been tested yielding similar results, suggesting not to eliminate any of the tested variables; these results are, of course, available from the author upon request

Table 27: Characteristics of German supervisory board size and supervisory board composition

Note: This includes boards of all German listed companies, except foreign companies, KGaAs and financial services firms. Lawyer is in 23 cases a employee representative (as part of a union or representative of the executive employees).

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Entire sample
Board size	10.7	10.3	9.9	10	10.1	9.9	9.9	9.9	9.8	9.8	10
Employee representatives	4.7	4.4	4.1	4.2	4.2	4.1	4.1	4.1	4	4	4.2
Union representatives	1.2	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Works council representatives	1.6	1.5	1.4	1.4	1.4	1.5	1.5	1.5	1.5	1.5	1.5
Independent employee representatives	1.9	1.8	1.7	1.6	1.7	1.5	1.6	1.5	1.5	1.5	1.6
Shareholder representatives											
Auditor	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Lawyer	0.6	0.6	0.6	0.5	0.6	0.5	0.6	0.6	0.5	0.5	0.6
Bank representatives	0.9	0.9	0.8	0.7	0.6	0.6	0.5	0.4	0.4	0.4	0.6
Former managing board member	0.4	0.3	0.3	0.3	0.3	0.4	0.3	0.3	0.3	0.3	0.3
Female representatives	0.8	0.8	0.7	0.8	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Female employee representatives	0.6	0.6	0.6	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Female union representatives	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1
Female works council representatives	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.2	0.2
Female independent employee representatives	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.3	0.3	0.3
Female shareholder representatives	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Observations	166	197	211	210	200	192	183	182	184	179	1,904

These changes on an overall level are also considerable on a firm level over time as the within variation for our dataset shows (displayed in Table 28). While the between standard variation is larger for nearly all variables, I still observe considerable variation within the firms allowing me to use fixed-effects estimations (as previously mentioned in section 7.5.2).

Table 28: Overall, between and within variation of main variables

Variable		Mean	Std. Dev.	Min	Max
cash_sales	overall	0.10	0.19	0.00	3.77
	between		0.13	0.00	0.99
	within		0.14	-0.69	3.19
cash_assets	overall	9.73	10.93	0.00	75.25
	between		9.28	0.03	50.73
	within		6.17	-24.06	54.62
size	overall	10.02	5.63	3.00	21.00
	between		5.57	3.00	21.00
	within		1.13	0.42	16.42
union_rep	overall	0.07	0.08	0.00	0.25
	between		0.07	0.00	0.18
	within		0.02	-0.10	0.21
woco_rep	overall	0.11	0.13	0.00	0.35
	between		0.12	0.00	0.35
	within		0.03	-0.14	0.32
ind_rep	overall	0.14	0.14	0.00	0.50
	between		0.13	0.00	0.40
	within		0.04	-0.25	0.41
auditor	overall	0.02	0.07	0.00	0.33
	between		0.06	0.00	0.33
	within		0.03	-0.28	0.24
lawyer	overall	0.08	0.13	0.00	1.00
	between		0.11	0.00	0.67
	within		0.06	-0.38	0.62
female	overall	0.08	0.11	0.00	0.67
	between		0.09	0.00	0.57
	within		0.05	-0.22	0.45

With regards to cash holdings of German companies from my sample, Table 29 provides an overview: The development of cash levels – both scaled by net assets and sales – shows only some variation with high levels of cash divided by net assets in the years 1999 and 2006. Both, total assets as well as absolute levels of cash holdings are growing. With regards to cash to net assets the German level is in line with prior research considering the German market (e.g., Schauten, et al. (2008), Ferreira and Vilela (2004)) and is with an average of 0.13 below the European average reported as 0.15 by both Ferreira and Vilela (2004)

and Schauten, et al. (2008); this is at the US average of 1990 (0.13), clearly below the US average of 2003 (0.41 – both observed by Dittmar and Mahrt-Smith (2007)) and at about the international average of 0.12 as reported by Kalcheva and Lins (2007).

Table 29: Cash holdings in Germany

Note: This includes boards of all German listed companies, except foreign companies and KGaAs and financial services firms.

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Entire sample
Full sample											
Cash/net assets											
Mean	0.13	0.16	0.14	0.1	0.11	0.12	0.14	0.14	0.16	0.13	0.13
Median	0.07	0.06	0.05	0.05	0.05	0.07	0.08	0.07	0.06	0.07	0.06
Standard deviation	0.15	0.35	0.33	0.14	0.19	0.18	0.21	0.24	0.29	0.19	0.24
25th percentile	0.03	0.03	0.02	0.02	0.02	0.03	0.04	0.04	0.03	0.03	0.03
75th percentile	0.17	0.14	0.12	0.1	0.11	0.14	0.15	0.15	0.16	0.14	0.14
Cash/sales											
Mean	0.1	0.1	0.09	0.08	0.08	0.09	0.11	0.12	0.12	0.11	0.1
Median	0.05	0.05	0.04	0.04	0.04	0.04	0.06	0.06	0.05	0.06	0.05
Standard deviation	0.13	0.18	0.17	0.13	0.14	0.14	0.16	0.22	0.3	0.29	0.19
25th percentile	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.02	0.02
75th percentile	0.12	0.12	0.09	0.09	0.08	0.11	0.13	0.11	0.11	0.12	0.11
Total assets - median (EUR '000)	5,022,019	5,305,097	6,526,901	7,074,117	6,754,991	6,853,403	7,164,104	7,935,186	8,470,152	8,925,058	6,995,630
Observations	166	197	211	210	200	192	183	182	184	179	1,904

Table 29 (continued)

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Entire sample
Mean by industry											
SIC 0 - Agriculture, Forestry, And Fishing											
Cash/net assets	0.2	0.21	0.17	0.19	0.21	0.21	0.15	0.1	0.11	0.13	0.17
Cash/sales	0.16	0.19	0.16	0.16	0.17	0.17	0.13	0.11	0.11	0.13	0.15
Observations	1	1	1	1	1	1	1	1	1	1	10
SIC 1 - Mining											
Cash/net assets	0.23	0.19	0.16	0.17	0.17	0.25	0.18	0.17	0.15	0.11	0.18
Cash/sales	0.22	0.15	0.09	0.09	0.09	0.13	0.09	0.09	0.07	0.06	0.11
Observations	5	5	5	4	4	4	4	4	5	5	45
SIC 2 - Construction											
Cash/net assets	0.12	0.1	0.12	0.08	0.07	0.08	0.1	0.07	0.19	0.07	0.1
Cash/sales	0.08	0.07	0.08	0.06	0.05	0.06	0.09	0.06	0.19	0.06	0.08
Observations	29	32	34	34	34	33	31	31	30	29	317
SIC 3 - Manufacturing											
Cash/net assets	0.14	0.12	0.11	0.1	0.11	0.13	0.16	0.17	0.15	0.15	0.13
Cash/sales	0.09	0.08	0.08	0.07	0.08	0.1	0.12	0.13	0.11	0.15	0.1
Observations	79	91	95	94	86	84	80	79	79	76	843
SIC 4 - Transportation, Communications, Electric, Gas, And Sanitary Services											
Cash/net assets	0.12	0.13	0.14	0.07	0.06	0.09	0.12	0.1	0.1	0.09	0.1
Cash/sales	0.15	0.18	0.07	0.08	0.11	0.15	0.17	0.16	0.13	0.12	0.13
Observations	11	14	16	17	15	12	12	13	13	13	136
SIC 5 - Wholesale/Retail Trade											
Cash/net assets	0.07	0.06	0.05	0.06	0.06	0.06	0.06	0.07	0.08	0.08	0.07
Cash/sales	0.05	0.04	0.04	0.03	0.03	0.03	0.04	0.05	0.05	0.05	0.04
Observations	25	29	28	26	26	24	24	23	25	25	255
SIC 7/8 - Services											
Cash/net assets	0.16	0.47	0.35	0.16	0.2	0.19	0.2	0.23	0.23	0.18	0.23
Cash/sales	0.19	0.22	0.22	0.13	0.13	0.12	0.12	0.2	0.14	0.1	0.15
Observations	16	25	32	34	34	34	31	31	31	30	298

Furthermore, Table 29 shows the mean cash to net assets and cash to sales rates per industry. The industry with the highest level of cash holdings is services, followed by Mining. Wholesale and retail trade show the lowest levels of cash holdings. As I am estimating all of my equations with firm fixed effects, I do not worry about time-invariant industry effects. All yearly effects are controlled for by my year dummies included in my regressions.

7.6.2. Univariate Results

Table 30 provides descriptive statistics for the main variables used in my analysis.

Table 30: Descriptive statistics (without year and industry dummies)

Note: Table 30 provides descriptive statistics for the dependent and main independent variables of my model. *Cash/sales* is the ratio of cash and equivalents to sales, *cash/assets* is the ratio of cash and equivalents to net assets (total assets minus cash and equivalents), *size* is the size of the supervisory board, *emp_rep* is the share of employee representatives of total board members, *union_rep* is the share of union representatives, *woco_rep* is the share of works council representatives, and *ind_rep* is the share of independent employee representatives. *Bank_rep* is the share of bank representatives of total board members, *former_bm* is the share of former managing board members, *auditor* the share of auditors, *lawyer* the share of lawyers, *female* the share of female directors, *union_female* the share of female union representatives, *works_female* the share of female works council representatives, *ind_female* the share of female independent employee representatives, and *shareholder_female* is the share of female shareholder rerpresentatives. *Assets* is the value of total assets and sales the value of total sales (both in EUR '000). *Leverage* is the leverage of the company defined as the ratio of total debt divided by total assets, *tobin_q* is the Tobin's Q calculated as follows: (market value of equity + book value of assets - book value of equity) / book value of assets, *cash_flow_na* is the cash flow (calculated as earnings after interest, dividend and taxes but before depreciation) divided by net assets, *free_cf_stdev* is the standard deviation of free cash flow for the past ten years, *net_working_capital_net_assets* is the ratio of working capital to net assets, *r_d_sales* is the ratio of R&D expenses to sales, *capex/sales* is the ratio of capital expenditures to sales, *cross_list* is a dummy variable equaling 1 if the firm is cross listed at a major stock exchange in the UK or US, *dividend_paid* is a dummy variable equaling 1 if a dividend was paid in the respective year, *emp_held* is the cumulative ownership of employees, *inst_held* is the cumulative ownership of institutional investors. The sample consists of all German companies listed in the DAX, MDAX, and SDAX for the years 1998 to 2007 with at least two years of available data, except firms from the financial services industry (SIC code 6) and KGaAs.

Variable	Mean	St.-dev.	Min	25th Per-centile	Median	75th Percen-tile	Max
Cash/sales	0.10	0.19	0.00	0.02	0.05	0.11	3.77
Cash/net assets	0.13	0.24	0.00	0.03	0.06	0.14	3.04
Board Size	10.02	5.63	3.00	6.00	9.00	12.00	21.00
emp_rep	0.32	0.21	0.00	0.00	0.33	0.50	0.50
union_rep	0.07	0.08	0.00	0.00	0.00	0.15	0.25
woco_rep	0.11	0.13	0.00	0.00	0.00	0.25	0.35
ind_rep	0.14	0.14	0.00	0.00	0.08	0.33	0.50
bank_rep	0.06	0.10	0.00	0.00	0.00	0.10	0.67
former_bm	0.04	0.08	0.00	0.00	0.00	0.05	0.50
auditor	0.02	0.07	0.00	0.00	0.00	0.00	0.33
lawyer	0.08	0.13	0.00	0.00	0.00	0.17	1.00
female	0.08	0.11	0.00	0.00	0.00	0.17	0.67
union_female	0.01	0.03	0.00	0.00	0.00	0.00	0.17
works_female	0.02	0.04	0.00	0.00	0.00	0.00	0.33
ind_female	0.03	0.07	0.00	0.00	0.00	0.00	0.50
sharehold-er_female	0.02	0.06	0.00	0.00	0.00	0.00	0.67
Assets (€ '000)	7,027,988	24,200,000	46	139,844	504,056	2,016,066	234,676,000
Sales (€ '000)	5,563,860	16,200,000	0	174,083	621,633	2,453,828	162,400,000
Leverage	0.26	0.19	0.00	0.11	0.24	0.38	1.71
Tobin's Q	1.54	1.62	0.20	1.00	1.19	1.54	51.80
Cash Flow/assets	0.15	3.66	-3.35	0.05	0.08	0.12	159.62
FCF_stdev	141,124	424,672	0	7,714	23,657	80,414	8,603,270
Working Capi-tal/assets	0.08	0.23	-2.08	-0.03	0.08	0.22	0.75
R&D/sales	0.02	0.03	0.000	0.00	0.00	0.02	0.27
CapEx/Sales	0.06	0.14	-0.06	0.02	0.04	0.07	4.94
cross_list	0.11	0.32	0.00	0.00	0.00	0.00	1.00
Dividend paid	0.72	0.45	0.00	0.00	1.00	1.00	1.00
emp_held	17.49	24.52	0.00	0.00	0.00	35.50	99.00
invest_held	2.76	8.06	0.00	0.00	0.00	0.00	94.00

As prior research (e.g., Harford, et al. (2008)) finds a relationship between firm size and the level of cash holdings as well as governance variables I expect a similar relationship for German firms. To assess this relationship, I assign all firms into four size classes according to the four quartiles of total assets. I am able to observe the same for German firms: all variables considered in Table 31 show significantly different medians for the first and fourth quartile, i.e., for the smallest and largest firms. As shown in Table 31 I observe higher level of cash holdings, both measured by the ratio of cash to sales as well as the ratio of cash to net assets, with larger companies. This difference in medians is significant across the first and second quartile and the third and fourth quartile as the results of the Wilcoxon rank-sum test show. With regards to board size and my variables of employee representation (*union_rep,*

woco_rep, and ind_rep) I observe the expected outcome as the German law regulates size and composition (see section 7.3). Finally, the share of female directors is higher with larger companies.

Table 31: Cash holdings and board size/characteristics relative to firm size

Note: I examine cash holdings and board size as well as board composition variables based on firm size (as measured by total assets). I sort firms into size quartiles each year and report median levels of cash holdings, board size and board composition within the quartiles. I use Wilcoxon rank-sum tests to examine weather the medians are significantly different between the observed and the next higher quartile. ***,**, and * imply statistical significance at the 0.01 significance at the 0.01, 0.05, and 0.10 levels, respectively.

	Cash/sales	Cash/assets	Board size	union_rep	woco_rep	ind_rep	female
Size quartile 1 (smallest)	0.04 ***	0.06 *	3 ***	0 ***	0	0 ***	0 ***
Size quartile 2	0.04	0.06 *	6 ***	0 ***	0 ***	0.17 ***	0 ***
Size quartile 3	0.05 ***	0.06	12 ***	0.17 ***	0.17 ***	0.17	0.06 *
Size quartile 4 (largest)	0.08 ***	0.07 **	20 ***	0.15	0.25	0.1 ***	0.05

The results of the pairwise Pearson correlation are shown in Table 32: interestingly, I observe negative correlations between the level of cash and my variables of employee representation, indicating lower cash levels with smaller boards as well as with rising levels of employee representation on the board. Surprisingly, higher levels of cash are associated with auditors on the board whereas lower levels of cash are observed with lawyers. Finally, I observe positive correlations between the variables of cash holdings and the share of female board members. All other correlations are as expected, as I find positive correlations between board size and variables of board composition.

Table 32: Pearson correlation

Note: Table 32 provides pearson correlations between the main variables used in my model. Values in parentheses show the significance level. ***,**, and * imply statistical significance at the 0.01, 0.05, and 0.10 levels, respectively.

	cash_sales	cash_assets	size	union_rep	woco_rep	ind_rep	auditor	lawyer	female
cash_sales	1.00								
cash_assets	0.75 ***	1.00							
	(0.00)								
size	-0.04	-0.11 ***	1.00						
	(0.13)	(0.00)							
union_rep	-0.07 ***	-0.11 ***	0.80 ***	1.00					
	(0.00)	(0.00)	(0.00)						
woco_rep	-0.03	-0.10 ***	0.55 ***	0.49 ***	1.00				
	(0.13)	(0.00)	(0.00)	(0.00)					
ind_rep	-0.06 ***	0.01	0.24 ***	0.20 ***	-0.32 ***	1.00			
	(0.01)	(0.68)	(0.00)	(0.00)	(0.00)				
auditor	0.04 *	0.01	-0.25 ***	-0.22 ***	-0.18 ***	-0.15 ***	1.00		
	(0.08)	(0.74)	(0.00)	(0.00)	(0.00)	(0.00)			
lawyer	-0.03	-0.05 **	-0.38 ***	-0.34 ***	-0.24 ***	-0.18 ***	0.03	1.00	
	(0.14)	(0.04)	(0.00)	(0.00)	(0.00)	(0.00)	(0.17)		
female	0.06 **	0.09 ***	0.07 ***	0.05 **	-0.06 ***	0.32 ***	-0.01	-0.05 **	1.00
	(0.01)	(0.00)	(0.00)	(0.02)	(0.01)	(0.00)	(0.68)	(0.02)	

These univariate results provide me with an indication about the interrelations between the levels of cash holdings and my variables of board size and board composition. The following multivariate analyses will shed further light on these relationships taking into consideration an array of control variables.

7.6.3. Multivariate Results

In a first series of fixed-effects regressions I analyze the relationship between the level of cash holdings and variables of board size and board composition, focusing on employee representation using my first model as shown in equation (1) above. The results of the first set of regressions are displayed in Table 33: in my first regression (1) I only test the effect of supervisory board size and find a significant negative effect of board size on the level of cash (i.e., each additional member reduces the cash to sales ratio by 12.5% on average), confirming my hypothesis that a larger board is more effective in monitoring cash levels and thus is associated with lower levels of cash[56]. With regards to the other independent variables I find a surprising result as large firms (measured by the logarithm total assets, *log_assets*) are associated with higher cash levels; I would have assumed that the access to capital markets is better for large firms and thus cash holdings out of a precautionary motive are lower. An explanation for this could be that firm size is a takeover deterrent and thus the need for low cash holdings is not as important for these firms. As expected, I see a negative effect of leverage on cash holdings, supporting the argument that debt has a disciplining effect on cash holdings. As I consider Tobin's Q as a proxy for profitable investment opportunities, it comes to no surprise that it is associated with higher cash levels in order to secure sufficient funding for these opportunities. Furthermore, the negative effect of working capital (*net_wc_na*) is also in line with my expectations, as I assume working capital as a proxy for liquid assets substitutes. Finally, both, the ratio of capital expenditures to sales (*capex_sales*) as well as my dummy for dividend payments (*dividend_paid*) are in line with my expectations as I see lower levels of cash holdings with higher capital expenditures and dividend payments. All other independent variables remain insignificant.

This result remains the same when I include the lagged value of my dependent variable *cash_sales* in my second regression (2); I assume that my firm fixed-effects regression does

56 This result is similar for all regressions when using the ratio of cash to net assets as well as an industry adjusted cash to sales ratio; these results are – of course – available from the author upon request.

not fully account for potential endogeneity. Adding the lagged value of my dependent variable gives me the possibility to examine the explanatory power of the independent variables above the explanatory power of the lagged value of my dependent variable itself (as used in prior research, e.g., Harford, et al. (2008), Dittmann, et al. (2010)).

In my next regression (3), I include insider ownership (*emp_held*) as well as institutional ownership (*invest_held*); as both variables are only available from 2002 onwards on Worldscope, the inclusion reduces the number of observations to 1,108 from 214 firms. Contrasting prior research, both variables do not show a significant effect on the level of cash holdings. Therefore, I do not include ownership in my further regressions on cash holdings. The results of the further independent variables remain similar with a stronger effect of board size (the coefficient almost doubled from regression (1)) and the surprising exceptions of Tobin's Q (*tobin_q*), which now has a significant negative effect on cash holdings, as well as the ratio of cash flow to net assets (*cash_flow_na*), which has in this regression a significant positive impact; this is in line with my expectations for this variable as I use it as a proxy for the severity of agency problems and I expect higher levels of cash with more severe agency problems.

In my fourth regression (4), I consider the first measure of board composition, employee representation. I observe that the level of cash holdings is significantly lower with employee representation (*emp_rep*) on the supervisory board (each additional employee representative in a board of 20 members reduces the cash to sales ratio by 16.1% on average). This confirms my hypothesis 2a that employee representation leads to lower cash holdings. While the direction and significance of all other independent variables remain the same, I observe that board size is not significant anymore when including employee representation. To further evaluate the effect of employee representation, I replace the general measure of employee representation with my detailed measures of union representatives (*union_rep*), works council representatives (*woco_rep*), and independent employee representatives (*ind_rep*) in regression (5). For all three variables I observe a negative effect on cash holdings once again confirming my hypothesis 2a. While the share of union representatives is slightly not significant (p-value of 0.11), both *woco_rep* and *ind_rep* are significant on the 99% respectively 95%-confidence interval level. Thus, the addition of works council representative in a 20 member board decreases the cash to sales ratio by 21.6% on average, the addition of an independent employee

representative decreases the ratio by 14.8% on average. All other variables show similar results to the outcomes of regression (4).

Table 33: Fixed-effects regression of measures of cash holdings on measures of board size and board composition

Note: Models 1-5 of table 33 provide the results of fixed-effects regressions with a measure of cash holdings cash_sales (defined as the ratio of cash and equivalents to sales) on measures of board size, board composition, and a set of control variables. All models include dummy variables for the year of observation. Standard errors are in parentheses. *, **, and *** imply statistical significance at the 0.10, 0.05, and 0.01 levels, respectively.

	(1) cash_sales	(2) cash_sales	(3) cash_sales	(4) cash_sales	(5) cash_sales
lag_cash_sales		0.000167	-0.000367	0.000163	0.000234
		(0.000695)	(0.000942)	(0.000692)	(0.000695)
Size	-0.0125***	-0.0125***	-0.0240***	-0.00279	-0.00299
	(0.00319)	(0.00320)	(0.00637)	(0.00424)	(0.00443)
emp_held			0.000421		
			(0.000408)		
invest_held			-0.000530		
			(0.000821)		
emp_rep				-0.322***	
				(0.0925)	
union_rep					-0.316
					(0.197)
woco_rep					-0.431***
					(0.145)
ind_rep					-0.295**
					(0.119)
log_ass	0.0239**	0.0239**	0.0363	0.0234**	0.0245**
	(0.0113)	(0.0113)	(0.0233)	(0.0113)	(0.0113)
leverage	-0.138***	-0.138***	-0.135***	-0.133***	-0.132***
	(0.0347)	(0.0347)	(0.0490)	(0.0346)	(0.0346)
tobin_q	0.0102**	0.0102**	-0.0370***	0.00970**	0.00989**
	(0.00492)	(0.00492)	(0.0116)	(0.00491)	(0.00491)
cash_flow_net_assets	-0.00232	-0.00232	0.175***	-0.00218	-0.00218
	(0.00189)	(0.00189)	(0.0311)	(0.00188)	(0.00188)
free_cf_stdev	1.63e-10	1.46e-10	-2.43e-08	2.99e-09	4.13e-09
	(1.41e-08)	(1.41e-08)	(1.77e-08)	(1.41e-08)	(1.41e-08)
net_wc_net_assets	-0.0725**	-0.0724**	-0.182***	-0.0651**	-0.0634**
	(0.0298)	(0.0298)	(0.0486)	(0.0298)	(0.0298)
r_d_sales	-0.251	-0.250	-0.409	-0.225	-0.230
	(0.271)	(0.271)	(0.430)	(0.270)	(0.270)
capex_sales	-0.0874***	-0.0874***	-0.341**	-0.0840***	-0.0837***
	(0.0311)	(0.0311)	(0.156)	(0.0310)	(0.0310)
cross_list	0.101**	0.101**	0.0486	0.0952**	0.0932**
	(0.0393)	(0.0393)	(0.0602)	(0.0392)	(0.0393)
dividend_paid	-0.0271**	-0.0271**	-0.0358*	-0.0267**	-0.0261**
	(0.0119)	(0.0119)	(0.0197)	(0.0118)	(0.0119)
Constant	-0.0318	-0.0319	0.00945	-0.0230	-0.0298
	(0.145)	(0.145)	(0.329)	(0.144)	(0.146)
Observations	1,904	1,904	1,108	1,904	1,904
R-squared	0.04	0.04	0.09	0.05	0.05

In a next set of regressions, which results are displayed in Table 34, I take a look at further measures of board composition: in my first regression (1) I include *bank_rep* measuring the share of bank representatives on the board. While the effect is positive and thus in line with my expectations the variable does not have a significant impact on the 90% confidence-level, but is with a p-value of 0.156 fairly close. Furthermore, size is once again significant and has, as observed in my first set of regressions, a negative effect on cash holdings (with almost similar magnitude). All other independent variables remain approximately the same from my observations in my first set of regressions. Similar results are obtained when considering the share of former managing board members (regression (2)): while the share does not have a significant effect all other explanatory variables show similar significance and direction as in (1).

Next, I analyze the effect of auditors on the board (regression (3)) and observe a negative effect, i.e., lower cash holdings are associated with the presence of an auditor on the board, supposedly due to more diligent monitoring by auditors; the addition of one further auditor on a 20 member board reduces the cash to sales ratio on average by 10.4%. This is in line with my hypothesis 2 as I expected lower cash levels with better monitoring (using auditors as a proxy for good monitoring). I observe the same effect with lawyers (an addition in a 20 member board reduces the cash to sales ratio on average by 12.7%), which show even a higher significance above the 99% confidence-level, in regression (4). In both regressions (3) and (4) no significant changes to the other independent variables can be observed.

The effect of female directors on cash holdings is analyzed in regressions (5) and (6): while I do not find an effect of female directors in general, I also observe no effect of female directors, which are employee representatives (i.e., *union_female*, *works_female*, *ind_female*); but I find a significant positive effect of female shareholder representatives. This is not in line with my hypothesis 2b but could be a sign that female directors from the shareholder side do have a longer term perspective and thus want to hedge risks by holding higher levels of cash; the addition of an additional female director from the shareholder side in a 20 member board increases the cash to sales by 10.6% on average. All other independent variables once again show the same effect as in previous regressions.

Finally, I evaluate the effect of all variables of board size and board composition in regression (7): Once again, with the addition of the variables of employee representation board size is not significant anymore. The same holds for the share of auditors as well as female shareholder representatives. All variables of employee representation (*union_rep*, *woco_rep*, *ind_rep*) are significant and negative confirming my hypothesis 2a; in a 20 member board the addition of an additional union representative decreases the cash to sales ratio by 19.7% on average, respectively, an additional works council representative by 22.9%, an additional independent employee representative by 16.1%. The remaining independent variables show the same significance and direction as in previous regressions

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Table 34: Fixed-effects regression of measures of cash holdings on measures of board size and board composition

Note: Models 1-7 of table 34 provide the results of fixed-effects regressions with a measure of cash holdings *cash_sales* (defined as the ratio of cash and equivalents to sales) on measures of board size, board composition, and a set of control variables. All models include dummy variables for the year of observation. Standard errors are in parentheses. *, **, and *** imply statistical significance at the 0.10, 0.05, and 0.01 levels, respectively.

	(1) cash_sales	(2) cash_sales	(3) cash_sales	(4) cash_sales	(5) cash_sales	(6) cash_sales	(7) cash_sales
lag_cash_sales	0.000182	0.000168	0.000164	0.000122	0.000158	0.000215	0.000247
	(0.000695)	(0.000695)	(0.000694)	(0.000691)	(0.000695)	(0.000696)	(0.000692)
Size	-0.012***	-0.013***	-0.013***	-0.014***	-0.013***	-0.012***	-0.003
	(0.00322)	(0.00320)	(0.00322)	(0.00319)	(0.00320)	(0.00324)	(0.00446)
bank_rep	0.101						0.0798
	(0.0705)						(0.0707)
former_bm		-0.00420					-0.0555
		(0.0817)					(0.0818)
auditor			-0.208*				-0.172
			(0.112)				(0.113)
lawyer				-0.253***			-0.268***
				(0.0547)			(0.0553)
female					0.0648		
					(0.0686)		
union_female						0.139	0.301
						(0.237)	(0.240)
works_female						-0.154	0.00430
						(0.188)	(0.194)
ind_female						-0.0579	-0.0434
						(0.125)	(0.127)
shareholder_female						0.211**	0.127
						(0.106)	(0.107)

Table 34 (continued)

	(1) cash_sales	(2) cash_sales	(3) cash_sales	(4) cash_sales	(5) cash_sales	(6) cash_sales	(7) cash_sales
union_rep							-0.393*
							(0.201)
woco_rep							-0.457***
							(0.147)
ind_rep							-0.322***
							(0.122)
log_assets	0.0246**	0.0239**	0.0233**	0.0264**	0.0242**	0.0247**	0.0278**
	(0.0113)	(0.0113)	(0.0113)	(0.0113)	(0.0113)	(0.0113)	(0.0113)
leverage	-0.137***	-0.138***	-0.139***	-0.136***	-0.139***	-0.136***	-0.126***
	(0.0347)	(0.0349)	(0.0346)	(0.0345)	(0.0347)	(0.0347)	(0.0346)
tobin_q	0.0102**	0.0102**	0.00997**	0.0119**	0.0100**	0.01000**	0.0111**
	(0.00492)	(0.00493)	(0.00492)	(0.00491)	(0.00493)	(0.00492)	(0.00490)
cash_flow_na	-0.00226	-0.00231	-0.00228	-0.00288	-0.00226	-0.00221	-0.00255
	(0.00189)	(0.00189)	(0.00188)	(0.00188)	(0.00189)	(0.00189)	(0.00187)
free_cf_stdev	5.95e-10	1.53e-10	-8.09e-10	-1.03e-09	1.80e-10	1.28e-10	2.97e-09
	(1.41e-08)	(1.41e-08)	(1.41e-08)	(1.40e-08)	(1.41e-08)	(1.41e-08)	(1.40e-08)
net_wc_na	-0.0697**	-0.0724**	-0.0729**	-0.0720**	-0.0735**	-0.0735**	-0.0631**
	(0.0298)	(0.0298)	(0.0298)	(0.0296)	(0.0298)	(0.0299)	(0.0297)
r_d_sales	-0.259	-0.251	-0.241	-0.275	-0.249	-0.236	-0.244
	(0.271)	(0.271)	(0.271)	(0.270)	(0.271)	(0.271)	(0.269)
capex_sales	-0.0871***	-0.0874***	-0.087***	-0.0649**	-0.088***	-0.088***	-0.0592*
	(0.0311)	(0.0311)	(0.0310)	(0.0313)	(0.0311)	(0.0311)	(0.0312)
cross_list	0.100**	0.101**	0.101**	0.101***	0.102***	0.0994**	0.0939**
	(0.0393)	(0.0394)	(0.0393)	(0.0391)	(0.0394)	(0.0395)	(0.0391)
dividend_paid	-0.0267**	-0.0271**	-0.0278**	-0.0268**	-0.0270**	-0.0283**	-0.0268**
	(0.0119)	(0.0119)	(0.0119)	(0.0118)	(0.0119)	(0.0119)	(0.0118)
Constant	-0.0554	-0.0319	-0.0124	-0.0347	-0.0374	-0.0474	-0.0419
	(0.146)	(0.145)	(0.145)	(0.144)	(0.145)	(0.145)	(0.146)
Observations	1,904	1,904	1,904	1,904	1,904	1,904	1,904
R-squared	0.04	0.04	0.05	0.06	0.04	0.05	0.07

To summarize, I am able to confirm my hypothesis 1 in all regressions besides the ones which include employee representation. I observe a negative effect of size on cash holdings, indicating that larger boards are better monitors when it comes to cash holdings. Furthermore, I am able to confirm my hypothesis 2a, as I see a negative impact of employee representation on cash holdings; this holds consistently for works council and independent employee representatives. While I find a significant positive effect for female shareholder directors when only considering female representation, I am not able to confirm this result when considering all variables of board composition. Finally, I do not find evidence for significant effects of bank representatives and former board members even though I find significant negative effects on cash holdings for both auditors and lawyers.

7.7. Conclusion

My research using the, to date, most comprehensive dataset on German supervisory boards covers three areas of research with respect to cash and the influence of corporate governance. More specifically, I consider the effect of board size and board composition on the level of cash holdings; I observe generally lower levels of cash with larger boards and also with employee representation on the board. Works council and independent employee representatives mainly drive the positive effect of employee representation. This is opposite to prior believes that employee representation leads to higher cash levels and thus less efficiency. I find the same positive effect with auditors and lawyers on the board. While I find no general effect of female directors, I observe that higher levels of cash are associated with female directors from the shareholder side. Considering these findings I am not able to provide support for current public policy initiatives in Germany aiming to reduce supervisory board size and employee representation on boards. I find that large boards and employee representation are not quite as efficient in keeping cash levels low as e.g., auditors and lawyers have but still show a positive effect. Further empirical work is required to shed more light in the area of cash and corporate governance and to validate my approach and results. Moreover, further research should be performed on the area of "internal governance mechanisms" (e.g., employee representation) and "external governance mechanisms" (e.g., the capital market) which would be especially interesting for the German market.

8. Summary and Implications

This thesis provides a detailed analysis on the effects of board size and composition of German supervisory boards in three important areas: first, firm performance, second, earnings management, and third, cash holdings. The aim to close the current research gap in German corporate governance research on supervisory boards has been achieved to a large extend; while partly conflicting, the results provide new insights and guidelines for the policy debate, academics, and ultimately board members. Additionally, an overview of the development of German supervisory boards in the recent years has been provided. Figure 9 provides an overview of the overall results of this thesis.

Figure 9: Overview of results - the effect of board size and composition on various measures

		Dependent variables					
		Operating performance		Firm valuation		Measures of management	
		ROE	ROIC	Tobin's Q	Total return	Earnings management	Cash holding
Independent variables	Board size	◯	◯	+	– –	◯	– – –
	Board composition						
	▪ Union representatives	◯	◯	◯	◯	n/a	◯
	▪ Works council reps.	◯	– –	◯	◯	n/a	– – –
	▪ Independent employee reps.	◯	◯	–	◯	n/a	– –
	▪ Female directors	n/a	n/a	n/a	n/a	+++	◯
	▪ Auditor	n/a	n/a	n/a	n/a	◯	–
	▪ Lawyer	n/a	n/a	n/a	n/a	◯	– – –

◯ Not significant	++/-- Positive/negative impact, p < 0.05
+/- Positive/negative impact, p < 0.1	+++/--- Positive/negative impact, p < 0.01

Source: Own illustration

As Figure 9 shows, the results of this thesis are mixed – with regards to operating performance only works council representatives show a significant and negative effect. Regard-

ing firm valuation, I find mixed effects when considering board size: while a larger board has a positive effect on the relative market valuation (measured by Tobin's Q), it has a negative effect on total shareholder return. Within the variables of board composition only independent employee representatives have a negative impact on Tobin's Q. When considering earnings management, I find that smaller boards are more efficient in controlling as they are associated with less earnings management. The same is true for female board directors; notably, this effect is mainly driven by independent female directors. Surprising as well is the negative effect of auditors on earnings management – i.e., more earnings management is observed when auditors are on the board. Finally, when researching the effects of board size and board composition, I again find a positive effect of smaller boards – i.e., smaller board are associated with smaller cash holdings. I observe the same positive effect for works council representatives, independent employee representatives, auditors, and lawyers.

These results of my research suggest that no general or generic strategy regarding board size and board composition is advisable. This also confirms earlier research on German supervisory boards that has yielded mixed results as well. But the results also show that the composition and size of the supervisory board should be diligently considered based on the current and future needs of the respective company; these needs could be manifold – from controlling to advising. This should be considered especially in the public policy debates, which often try to "fix" all problems by e.g., introducing quotas, etc.

Given the broad empirical basis of this research, further research should focus on more detailed characteristics of supervisory board members to shed further light on the composition of the "ideal" supervisory board. Things to be considered could be age of the members, educational background, personal and professional relationships with other supervisory and management board members. Another interesting expansion of this research would be the area of unlisted companies, which have a large share of the German economy; these companies are usually family-owned, of all sizes and usually monitored by supervisory boards as well.

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Appendix

Appendix Table 1: Comparison of winzorized values vs. non-winzorized values for dependent variables and operating margin

Variable	Type	Maximum extreme values					Minimum extreme values				
		5	4	3	2	1	1	2	3	4	5
Tobin Q	Non-winzorized	13	17	21	28	52	0.20	0.40	0.41	0.42	0.47
	Winzorized	12	12	12	12	12	0.47	0.47	0.47	0.47	0.47
Total return index	Non-winzorized	5,478	6,302	7,064	11,680	17,418	0.22	0.24	0.38	0.54	0.65
	Winzorized	4,153	4,153	4,153	4,153	4,153	0.67	0.67	0.67	0.67	0.67
ROE	Non-winzorized	562	809	812	1,457	179,287	-9,751	-3,373	-1,534	-1,524	-1,363
	Winzorized	483	483	483	483	483	-1,162	-1,162	-1,162	-1,162	-1,162
ROIC	Non-winzorized	99	102	103	223	379	-545	-520	-322	-229	-203
	Winzorized	98	98	98	98	98	-189	-189	-189	-189	-189
Operating margin	Non-winzorized	96	98	98	130	174	-2,294	-2,058	-660	-451	-412
	Winzorized	95	95	95	95	95	-341	-341	-341	-341	-341

Appendix Table 2: Fixed effects regressions of various performance measures on board size and composition

Note: This table includes all regressions with a regular fixed effects estimation (model (1)) and a clustered fixed effects estimation (model (2)). Z values are in parentheses. *, **, and *** imply statistical significance at the 0.10, 0.05, and 0.01 levels, respectively.

	Tobin's Q		Total return index		ROE		ROIC	
	Non-winzorized	Winzorized	Non-winzorized	Winzorized	Non-winzorized	Winzorized	Non-winzorized	Winzorized
size	0.0636**	0.0366**	-15.41**	-8.489**	131.8*	1.178	0.269	0.470
	(0.0294)	(0.0183)	(7.504)	(3.800)	(72.53)	(1.740)	(0.488)	(0.342)
union_rep	2.090	0.933	-153.8	-48.57	3,102	54.33	-4.875	-8.540
	(1.449)	(0.901)	(369.4)	(187.1)	(3,571)	(85.65)	(24.02)	(16.82)
woco_rep	-0.775	-0.588	-0.400	7.357	-160.4	-71.50	-29.55	-25.85**
	(1.127)	(0.700)	(287.4)	(145.5)	(2,777)	(66.60)	(18.68)	(13.08)
ind_rep	-1.765*	-1.138**	151.9	67.93	-1,953	-48.88	0.0563	-1.569
	(0.909)	(0.565)	(231.9)	(117.4)	(2,241)	(53.75)	(15.07)	(10.55)
bank_rep	-0.743	-0.386	126.2	62.14	-848.7	-19.24	7.584	3.579
	(0.527)	(0.327)	(134.3)	(67.99)	(1,298)	(31.13)	(8.729)	(6.111)
former_bm	-2.217***	-1.670***	110.6	112.6	126.6	-79.44**	-42.27***	-17.84**
	(0.632)	(0.393)	(161.0)	(81.55)	(1,557)	(37.33)	(10.47)	(7.330)
experience	0.00243	-0.00463	1.742	1.468	12.18	0.188	0.0353	0.0339
	(0.0135)	(0.00837)	(3.435)	(1.739)	(33.19)	(0.796)	(0.223)	(0.156)
log_ass	-1.168***	-0.499***	319.9***	181.9***	-2,924***	7.186*	4.891***	3.175***
	(0.0647)	(0.0402)	(16.49)	(8.351)	(159.4)	(3.823)	(1.072)	(0.751)
sales	2.54e-08**	1.48e-08**	-3.74e-06	-1.80e-06	4.22e-05*	4.36e-07	-2.31e-09	3.61e-08
	(1.03e-08)	(6.40e-09)	(2.66e-06)	(1.33e-06)	(2.54e-05)	(6.09e-07)	(1.71e-07)	(1.20e-07)
ind_diversified	-0.0904	-0.0492	35.22	10.81	-166.9	-8.615	-2.500*	-1.211
	(0.0903)	(0.0561)	(23.04)	(11.66)	(222.5)	(5.336)	(1.497)	(1.048)
geo_diversified	-0.304**	-0.177**	78.67**	14.44	-47.95	-10.56	-2.808	-1.774
	(0.121)	(0.0755)	(30.96)	(15.67)	(299.2)	(7.176)	(2.013)	(1.409)
herfindahl	-0.00132	-0.00137	-0.131	-0.210	-0.675	0.153	0.712***	0.193***
	(0.00389)	(0.00242)	(0.991)	(0.502)	(9.583)	(0.230)	(0.0645)	(0.0451)
block_25	-0.171	-0.232***	-46.08*	-14.84	86.03	-5.429	-1.746	-1.636
	(0.106)	(0.0659)	(27.05)	(13.69)	(261.3)	(6.267)	(1.758)	(1.231)
block_50	0.0213	0.0608	7.147	2.297	-91.35	8.671	2.461	1.484
	(0.116)	(0.0723)	(29.65)	(15.02)	(286.6)	(6.875)	(1.928)	(1.350)
block_75	-0.139	-0.0337	20.47	0.939	-262.4	8.119	-1.934	-0.421
	(0.138)	(0.0860)	(35.26)	(17.86)	(340.8)	(8.175)	(2.293)	(1.605)
leverage	0.153	-0.199	-218.0***	-164.3***	1,416**	-76.27***	-11.90***	-13.71***
	(0.241)	(0.150)	(61.50)	(31.14)	(594.5)	(14.26)	(3.999)	(2.799)
capex_sales	-0.00702	-0.00192	9.578	8.831**	6.393	-3.087	-0.834	-0.809**
	(0.0348)	(0.0216)	(8.875)	(4.494)	(85.78)	(2.058)	(0.577)	(0.404)
op_mar_win	0.00160	-0.00114	-0.904***	-0.249*	18.28***	1.073***	0.249***	0.243***
	(0.00116)	(0.000724)	(0.297)	(0.150)	(2.870)	(0.0688)	(0.0193)	(0.0135)
restruct	-0.791**	-0.558***	76.20	23.46	-999.1	-34.97*	3.432	2.701
	(0.334)	(0.208)	(85.12)	(43.11)	(822.8)	(19.73)	(5.535)	(3.875)
m_and_a	0.294	0.362**	67.50	49.84*	-137.3	-17.06	0.917	0.670
	(0.230)	(0.143)	(58.63)	(29.69)	(566.7)	(13.59)	(3.812)	(2.669)

Appendix Table 2 (continued)

	Tobin's Q		Total return index		ROE		ROIC	
	Non-winzorized	Winzorized	Non-winzorized	Winzorized	Non-winzorized	Winzorized	Non-winzorized	Winzorized
Constant	17.48***	8.507***	-3,973***	-2,153***	38,680***	-70.07	-50.38***	-31.09***
	(0.896)	(0.557)	(228.4)	(115.7)	(2,208)	(52.96)	(14.85)	(10.40)
Observations	2,382	2,382	2,381	2,382	2,382	2,382	2,382	2,382
R^2	0.185	0.175	0.204	0.282	0.153	0.149	0.176	0.207

Appendix Table 3: Fixed effects regressions of various performance measures on board size and composition

Note: This table includes all regressions with a regular fixed effects estimation (model (1)) and a clustered fixed effects estimation (model (2)). Z values are in parentheses. *, **, and *** imply statistical significance at the 0.10, 0.05, and 0.01 levels, respectively.

	Tobin's Q		Total return index		ROE		ROIC	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Size	0.0366**	0.0366	-8.489**	-8.489	1.178	1.178	0.470	0.470
	(0.0183)	(0.0246)	(3.800)	(6.637)	(1.740)	(2.067)	(0.342)	(0.340)
union_rep	0.933	0.933	-48.57	-48.57	54.33	54.33	-8.540	-8.540
	(0.901)	(1.270)	(187.1)	(209.0)	(85.65)	(86.26)	(16.82)	(15.47)
woco_rep	-0.588	-0.588	7.357	7.357	-71.50	-71.50	-25.85**	-25.85*
	(0.700)	(0.807)	(145.5)	(108.8)	(66.60)	(53.93)	(13.08)	(13.86)
ind_rep	-1.138**	-1.138	67.93	67.93	-48.88	-48.88	-1.569	-1.569
	(0.565)	(0.796)	(117.4)	(92.32)	(53.75)	(37.83)	(10.55)	(9.785)
bank_rep	-0.386	-0.386	62.14	62.14	-19.24	-19.24	3.579	3.579
	(0.327)	(0.591)	(67.99)	(73.64)	(31.13)	(38.95)	(6.111)	(11.40)
former_bm	-1.670***	-1.670*	112.6	112.6	-79.44**	-79.44	-17.84**	-17.84
	(0.393)	(0.990)	(81.55)	(106.1)	(37.33)	(57.17)	(7.330)	(12.77)
Experience	-0.00463	-0.00463	1.468	1.468	0.188	0.188	0.0339	0.0339
	(0.00837)	(0.00848)	(1.739)	(1.630)	(0.796)	(0.491)	(0.156)	(0.118)
log_ass	-0.499***	-0.499***	181.9***	181.9***	7.186*	7.186	3.175***	3.175
	(0.0402)	(0.125)	(8.351)	(49.45)	(3.823)	(8.753)	(0.751)	(1.951)
Sales	1.48e-08**	1.48e-08***	-1.80e-06	-1.80e-06	4.36e-07	4.36e-07**	3.61e-08	3.61e-08
	(6.40e-09)	(5.16e-09)	(1.33e-06)	(1.46e-06)	(6.09e-07)	(2.21e-07)	(1.20e-07)	(5.25e-08)
ind_diversified	-0.0492	-0.0492	10.81	10.81	-8.615	-8.615	-1.211	-1.211
	(0.0561)	(0.0578)	(11.66)	(12.10)	(5.336)	(7.161)	(1.048)	(1.089)
geo_diversified	-0.177**	-0.177	14.44	14.44	-10.56	-10.56*	-1.774	-1.774
	(0.0755)	(0.143)	(15.67)	(22.75)	(7.176)	(5.415)	(1.409)	(1.694)
Herfindahl	-0.00137	-0.00137	-0.210	-0.210**	0.153	0.153	0.193***	0.193
	(0.00242)	(0.00124)	(0.502)	(0.0840)	(0.230)	(0.111)	(0.0451)	(0.144)
block_25	-0.232***	-0.232**	-14.84	-14.84	-5.429	-5.429	-1.636	-1.636
	(0.0659)	(0.0923)	(13.69)	(18.42)	(6.267)	(7.732)	(1.231)	(1.052)
block_50	0.0608	0.0608	2.297	2.297	8.671	8.671	1.484	1.484
	(0.0723)	(0.0758)	(15.02)	(17.76)	(6.875)	(8.381)	(1.350)	(1.369)
block_75	-0.0337	-0.0337	0.939	0.939	8.119	8.119	-0.421	-0.421
	(0.0860)	(0.0909)	(17.86)	(16.83)	(8.175)	(8.771)	(1.605)	(1.837)
leverage	-0.199	-0.199	-164.3***	-164.3***	-76.27***	-76.27***	-13.71***	-13.71*
	(0.150)	(0.295)	(31.14)	(61.26)	(14.26)	(19.70)	(2.799)	(7.815)
capex_sales	-0.00192	-0.00192	8.831**	8.831	-3.087	-3.087***	-0.809**	-0.809***
	(0.0216)	(0.0247)	(4.494)	(7.881)	(2.058)	(0.941)	(0.404)	(0.190)
op_mar_win	-0.00114	-0.00114	-0.249*	-0.249	1.073***	1.073***	0.243***	0.243***
	(0.000724)	(0.00269)	(0.150)	(0.288)	(0.0688)	(0.272)	(0.0135)	(0.0402)
restruct	-0.558***	-0.558**	23.46	23.46	-34.97*	-34.97	2.701	2.701
	(0.208)	(0.243)	(43.11)	(29.37)	(19.73)	(54.74)	(3.875)	(7.974)
m_and_a	0.362**	0.362**	49.84*	49.84***	-17.06	-17.06	0.670	0.670
	(0.143)	(0.140)	(29.69)	(16.34)	(13.59)	(18.51)	(2.669)	(2.436)

Appendix Table 3 (continued)

	Tobin's Q		Total return index		ROE		ROIC	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Constant	8.507***	8.507***	-2,153***	-2,153***	-70.07	-70.07	-31.09***	-31.09
	(0.557)	(1.625)	(115.7)	(642.6)	(52.96)	(123.2)	(10.40)	(24.27)
Observations	2,382	2,382	2,382	2,382	2,382	2,382	2,382	2,382
R^2	0.175	0.175	0.282	0.282	0.149	0.149	0.207	0.207

Appendix Table 4: List of firms in dataset and years of inclusion

FIRM	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
A.S. CRÉATION TAPETEN AG	1	1	1	1	1	1	1	1	1	1
AAREAL BANK AG					1	1	1	1	1	1
ADCAPITAL AG	1	1	1	1	1	1	1	1	1	1
ADIDAS AG	1	1	1	1	1	1	1	1	1	1
AGIV REAL ESTATE AG	1	1	1	1	1	1				
AHLERS AG	1	1	1	1	1	1	1	1	1	1
AIG INTERT. REAL ESTATE KGAA					1	1	1	1	1	1
AIR BERLIN PLC									1	1
ALLIANZ SE	1	1	1	1	1	1	1	1	1	1
ALTA AG	1	1	1	1	1	1	1	1	1	1
AMADEUS FIRE AG		1	1	1	1	1	1	1	1	1
AMB GENERALI HOLDING AG	1	1	1	1	1	1	1	1	1	1
APCOA PARKING AG	1	1	1	1	1	1				
ARCANDOR AG	1	1	1	1	1	1	1	1	1	1
ARNDT AUTOVERMIETUNG			1	1	1					
ARQUES INDUSTRIES AG					1	1	1	1	1	1
AUTANIA AG	1	1	1	1	1	1	1	1	1	
AVA AG	1	1	1	1	1	1	1			
AWD HOLDING AG			1	1	1	1	1	1	1	1
AXA KONZERN AG	1	1	1	1	1	1	1	1	1	
AXEL SPRINGER AG	1	1	1	1	1	1	1	1	1	1
AZEGO AG		1	1	1	1	1	1	1	1	
B.U.S. UMWELT-SERVICE AG	1	1	1	1						
BAADER BANK AG	1	1	1	1	1	1	1	1	1	1
BABCOCK BORSIG AG	1	1	1	1	1					
BALDA AG		1	1	1	1	1	1	1	1	1
BASF SE	1	1	1	1	1	1	1	1	1	1
BAUER AG									1	1
BAUVEREIN ZU HAMBURG AG								1	1	1
BAYER AG	1	1	1	1	1	1	1	1	1	1
BAYER SCHERING PHARMA AG	1	1	1	1	1	1	1	1	1	1
BAYER.HYPO- UND VEREINSBANK AG	1	1	1	1	1	1	1	1	1	1
BAYWA AG		1	1	1	1	1	1	1	1	1
BEATE UHSE AG		1	1	1	1	1	1	1	1	1
BEIERSDORF AG	1	1	1	1	1	1	1	1	1	1
BERENTZEN-GRUPPE AG	1	1	1	1	1	1	1	1	1	1
BERU AG	1	1	1	1	1	1	1	1	1	1
BEWAG AG	1	1	1	1	1					
BHF BANK AG	1	1	1	1	1					

Appendix Table 4 (continued)

FIRM	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
BHW AG	1	1	1	1	1	1	1	1	1	1
BIEN-ZENKER AG	1	1	1	1	1	1	1	1	1	1
BIJOU BRIGITTE AG	1	1	1	1	1	1	1	1	1	1
BILFINGER BERGER AG	1	1	1	1	1	1	1	1	1	1
BIOTEST AG	1	1	1	1	1	1	1	1	1	1
BMP AG		1	1	1	1	1	1	1	1	1
BMW AG	1	1	1	1	1	1	1	1	1	1
BÖWE SYSTEC AG	1	1	1	1	1	1	1	1	1	1
BRAU UND BRUNNEN AG	1	1	1	1	1	1				
BRÜDER MANNESMANN AG	1	1	1	1	1	1	1	1	1	1
BUDERUS AG	1	1	1	1	1	1				
BURGBAD AG	1	1	1	1	1	1	1	1	1	1
C.A.T. OIL AG									1	1
CAPITAL STAGE AG	1	1	1	1	1	1	1	1	1	1
CARGOLIFTER AG			1	1						
CASH.LIFE AG	1	1	1	1	1	1	1	1	1	1
CE CONSUMER ELECTRONICS AG	1	1	1	1	1	1	1	1	1	1
CEAG AG	1	1	1	1	1	1	1	1	1	1
CELANESE AG		1	1	1	1	1	1	1		
CELESIO AG	1	1	1	1	1	1	1	1	1	1
CENTROTEC SUSTAIBLE AG	1	1	1	1	1	1	1	1	1	1
CEWE COLOR HOLDING AG	1	1	1	1	1	1	1	1	1	1
CINEMAXX AG	1	1	1	1	1	1	1	1	1	1
COLONIA REAL ESTATE AG			1	1	1	1	1	1	1	1
COMDIRECT BANK AG			1	1	1	1	1	1	1	1
COMMERZBANK AG	1	1	1	1	1	1	1	1	1	1
CONCORD INVESTMENT BANK AG	1	1	1	1	1	1	1	1	1	1
CONDOMI AG		1	1	1	1	1				
CONTINENTAL AG	1	1	1	1	1	1	1	1	1	1
CREATON AG	1	1	1	1	1	1	1	1	1	1
CTS EVENTIM AG			1	1	1	1	1	1	1	1
CURANUM AG	1	1	1	1	1	1	1	1	1	1
D.LOGISTICS AG		1	1	1	1	1	1	1	1	1
D+S EUROPE AG			1	1	1	1	1	1	1	1
DAB BANK AG		1	1	1	1	1	1	1	1	1
DAIMLER AG	1	1	1	1	1	1	1	1	1	1
DATA MODUL AG	1	1	1	1	1	1	1	1	1	1
DBV WINTERTHUR AG	1	1	1	1	1	1	1	1	1	1
DEGUSSA AG	1	1	1	1	1	1	1	1	1	1
DEMAG CRANES AG									1	1
DEPFA DEUTSCHE PFANDBRIEF BANK AG	1	1	1	1	1	1	1	1	1	
DEUTSCHE BANK AG	1	1	1	1	1	1	1	1	1	1
DEUTSCHE BETEILIGUNGS AG	1	1	1	1	1	1	1	1	1	1

Appendix Table 4 (continued)

FIRM	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
DEUTSCHE BÖRSE AG				1	1	1	1	1	1	1
DEUTSCHE EUROSHOP AG			1	1	1	1	1	1	1	1
DEUTSCHE INDUSTRIE SERVICE AG	1	1	1	1	1	1	1	1	1	1
DEUTSCHE LUFTHANSA AG	1	1	1	1	1	1	1	1	1	1
DEUTSCHE POST AG			1	1	1	1	1	1	1	1
DEUTSCHE POSTBANK AG							1	1	1	1
DEUTSCHE STEINZEUG AG	1	1	1	1	1	1	1	1	1	1
DEUTSCHE TELEKOM AG	1	1	1	1	1	1	1	1	1	1
DEUTSCHE WOHNEN AG		1	1	1	1	1	1	1	1	1
DEUTZ AG	1	1	1	1	1	1	1	1	1	1
DIC ASSET AG						1	1	1	1	1
DOUGLAS HOLDING AG	1	1	1	1	1	1	1	1	1	1
DR. ING. HC. F. PORSCHE AG	1	1	1	1	1	1	1	1	1	1
DR.SCHELLER COSMETICS AG		1	1	1	1	1	1	1	1	1
DRÄGERWERK AG	1	1	1	1	1	1	1	1	1	1
DRESDNER BANK AG	1	1	1	1	1	1	1	1	1	1
DSL HOLDING AG	1	1	1							
DÜRR AG	1	1	1	1	1	1	1	1	1	1
DYCKERHOFF AG	1	1	1	1	1	1	1	1	1	1
E.ON AG			1	1	1	1	1	1	1	1
EADS N.V.			1	1	1	1	1	1	1	1
EDSCHA AG		1	1	1	1	1				
EFF-EFF FRITZ FUSS GMBH & CO. KGAA	1	1	1	1	1	1				
EHLEBRACHT AG	1	1	1	1	1	1	1	1	1	1
EICHBORN AG			1	1	1	1	1	1	1	1
EINHELL AG	1	1	1	1	1	1	1	1	1	1
ELEXIS AG		1	1	1	1	1	1	1	1	1
ELRINGKLINGER AG			1	1	1	1	1	1	1	1
EM.TV AG	1	1	1	1	1	1	1	1	1	1
EPCOS AG		1	1	1	1	1	1	1	1	1
ESCADA AG	1	1	1	1	1	1	1	1	1	1
ESSANELLE HAIR GROUP AG				1	1	1	1	1	1	1
EUROBIKE AG	1	1	1	1	1					
FAG KUGELFISCHER AG	1	1	1	1						
FIELMANN AG	1	1	1	1	1	1	1	1	1	1
FRAPORT AG				1	1	1	1	1	1	1
FRESENIUS MEDICAL CARE AG	1	1	1	1	1	1	1	1	1	1
FRESENIUS SE	1	1	1	1	1	1	1	1	1	1
FRITZ NOLS GLOBAL EQUITY SERVICES AG	1	1	1	1	1					
FUCHS PETROLUB AG	1	1	1	1	1	1	1	1	1	1
GAGFAH S.A.									1	1

Appendix Table 4 (continued)

FIRM	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
GARDENA HOLDING AG	1	1	1	1	1					
GEA AG	1	1	1	1	1	1				
GEA GROUP AG	1	1	1	1	1	1	1	1	1	1
GERATHERM MEDICAL AG			1	1	1	1	1	1	1	1
GERICOM AG			1	1	1	1	1	1	1	1
GERMAN BROKERS AG		1	1	1						
GERRESHEIMER GLAS AG	1	1	1	1	1					
GERRY WEBER AG	1	1	1	1	1	1	1	1	1	1
GESCO AG	1	1	1	1	1	1	1	1	1	1
GFK AG		1	1	1	1	1	1	1	1	1
GILDEMEISTER AG	1	1	1	1	1	1	1	1	1	1
GOLD ZACK AG	1	1	1	1						
GONTARD+METALLBANK AG		1	1	1						
GRAMMER AG	1	1	1	1	1	1	1	1	1	1
GRAPHIT KROPFMÜHL AG	1	1	1	1	1	1	1	1	1	1
GRENKELEASING AG			1	1	1	1	1	1	1	1
H&R WASAG AG	1	1	1	1	1	1	1	1	1	1
HACH AG	1	1	1							
HANNOVER RÜCKVERSICHERUNG AG	1	1	1	1	1	1	1	1	1	1
HAWESKO HOLDING AG	1	1	1	1	1	1	1	1	1	1
HCI CAPITAL AG								1	1	1
HEIDELBERGCEMENT AG	1	1	1	1	1	1	1	1	1	1
HEIDELBERGER DRUCKMASCHINEN AG	1	1	1	1	1	1	1	1	1	1
HEINKEL AG		1	1	1	1	1				
HENKEL AG & CO. KGAA	1	1	1	1	1	1	1	1	1	1
HERLITZ AG	1	1	1	1	1	1	1	1	1	1
HIGHLIGHT COMMUNICATIONS AG		1	1	1	1	1	1	1	1	1
HOCHTIEF AG	1	1	1	1	1	1	1	1	1	1
HOECHST AG	1	1	1	1	1	1				
HOLSTEN BRAUEREI AG	1	1	1	1	1	1	1	1		
HORNBACH BAUMARKT AG	1	1	1	1	1	1	1	1	1	1
HORNBACH HOLDING AG	1	1	1	1	1	1	1	1	1	1
HUGO BOSS AG	1	1	1	1	1	1	1	1	1	1
HYMER AG	1	1	1	1	1	1	1	1	1	1
HYPO REAL ESTATE HOLDING AG						1	1	1	1	1
IKB DEUTSCHE INDUSTRIEBANK AG	1	1	1	1	1	1	1	1	1	1
IM INTERTIOLMEDIA AG			1	1	1	1	1	1	1	1
INDUS HOLDING AG	1	1	1	1	1	1	1	1	1	1
INFINEON TECHNOLOGIES AG			1	1	1	1	1	1	1	1
INNOTEC TSS AG	1	1	1	1	1	1	1	1	1	1

Appendix Table 4 (continued)

FIRM	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
INTERHYP AG								1	1	1
IVG AG	1	1	1	1	1	1	1	1	1	1
JAXX AG		1	1	1	1	1	1	1	1	1
JENOPTIK AG	1	1	1	1	1	1	1	1	1	1
JUNGHEINRICH AG	1	1	1	1	1	1	1	1	1	1
K&M MÖBEL AG	1	1	1	1	1					
K+S AG	1	1	1	1	1	1	1	1	1	1
KAMPA AG	1	1	1	1	1	1	1	1	1	1
KAMPS AG	1	1	1	1	1					
KÄSSBOHRER GELÄNDEFAHR-ZEUG AG	1	1	1	1	1	1	1	1	1	1
KAUFRING AG	1	1	1							
KIEKERT AG	1	1	1	1						
KLING JELKO WERTPAPIERHAN-DELSBANK AG	1	1	1	1						
KLÖCKNER & CO AG									1	1
KLÖCKNER WERKE AG	1	1	1	1	1	1	1	1	1	1
KNORR CAPITAL PARTNER		1	1							
KÖHLER & KRENZER FASHION AG		1	1	1	1	1	1	1	1	
KOLBENSCHMIDT PIERBURG AG	1	1	1	1	1	1	1	1	1	
KÖNIG & BAUER AG	1	1	1	1	1	1	1	1	1	1
KRONES AG	1	1	1	1	1	1	1	1	1	1
KSB AG	1	1	1	1	1	1	1	1	1	1
KUKA AG	1	1	1	1	1	1	1	1	1	1
KWS SAAT AG	1	1	1	1	1	1	1	1	1	1
LAHMEYER AG	1	1								
LANDESBANK BERLIN HOLDING AG	1	1	1	1	1	1	1	1	1	1
LANXESS AG								1	1	1
LEIFHEIT AG	1	1	1	1	1	1	1	1	1	1
LEONI AG	1	1	1	1	1	1	1	1	1	1
LINDE AG	1	1	1	1	1	1	1	1	1	1
LOEWE AG		1	1	1	1	1	1	1	1	1
LOGWIN AG			1	1	1	1	1	1	1	1
LUDWIG BECK AG	1	1	1	1	1	1	1	1	1	1
M.A.X. AUTOMATION AG	1	1	1	1	1	1	1	1	1	1
MAN AG	1	1	1	1	1	1	1	1	1	1
MANNESMANN AG	1	1	1	1						
MANNHEIMER AG	1	1	1	1	1	1	1	1	1	1
MARSEILLE-KLINIKEN AG	1	1	1	1	1	1	1	1	1	1
MASTERFLEX AG			1	1	1	1	1	1	1	1
MATERNUS KLINIKEN AG	1	1	1	1	1	1	1	1	1	1
MEDICLIN AG			1	1	1	1	1	1	1	1
MEDION AG		1	1	1	1	1	1	1	1	1

Appendix Table 4 (continued)

FIRM	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
MEDISA AG			1	1	1	1	1	1	1	1
MERCK KGAA	1	1	1	1	1	1	1	1	1	1
METRO AG	1	1	1	1	1	1	1	1	1	1
MISTRAL MEDIA AG	1	1	1	1	1	1	1	1	1	1
MLP AG	1	1	1	1	1	1	1	1	1	1
MOEBEL WALTHER AG	1	1	1	1	1	1	1	1	1	1
MPC MÜNCHMEYER PE-TERS.CAP.AG			1	1	1	1	1	1	1	1
MTU AERO ENGINES AG								1	1	1
MÜNCHENER RÜCKVERSICHER-UNGS-GES. AG	1	1	1	1	1	1	1	1	1	1
MVV ENERGIE AG		1	1	1	1	1	1	1	1	1
MWB WERTPAPIERHANDELSBANK AG		1	1	1	1	1	1	1	1	1
NESCHEN AG		1	1	1	1	1	1	1	1	1
NORDDEUTSCHE AFFINERIE AG	1	1	1	1	1	1	1	1	1	1
NÜRNBERGER BETEILIGUNGS AG	1	1	1	1	1	1	1	1	1	1
OLYMPIA FLEXGROUP AG	1	1	1	1	1	1	1	1	1	1
PA POWER AUTOMATION	1	1	1	1	1	1	1	1	1	1
PATRIZIA IMMOBILIEN AG									1	1
PFLEIDERER AG	1	1	1	1	1	1	1	1	1	1
PHILIPP HOLZMANN AG	1	1	1	1						
PHOENIX AG	1	1	1	1	1	1	1			
PLETTAC AG	1	1	1	1						
PONGS & ZAHN AG	1	1	1	1	1	1	1	1	1	1
PORTA SYSTEMS AG	1	1	1	1						
PRAKTIKER AG								1	1	1
PREMIERE AG								1	1	1
PROCON MULTIMEDIA AG		1	1	1	1	1	1	1	1	1
PROGRESS-WERK OBERKIRCH AG	1	1	1	1	1	1	1	1	1	1
PROSIEBENSAT1 AG	1	1	1	1	1	1	1	1	1	1
PUMA AG	1	1	1	1	1	1	1	1	1	1
QUANTE AG	1	1	1	1						
R. STAHL AG	1	1	1	1	1	1	1	1	1	1
RATIOL AG			1	1	1	1	1	1	1	1
RHEINMETALL AG	1	1	1	1	1	1	1	1	1	1
RHÖN-KLINIKUM AG	1	1	1	1	1	1	1	1	1	1
RINOL AG	1	1	1	1	1	1	1	1		
ROHWEDDER AG			1	1	1	1	1	1	1	1
RSE GRUNDBESITZ- UND BETEILI-GUNGS AG	1	1	1	1	1	1	1	1	1	1
RWE AG	1	1	1	1	1	1	1	1	1	1
SACORP PHARMAHOLDING AG	1	1	1	1	1	1	1	1	1	1
SALZGITTER AG	1	1	1	1	1	1	1	1	1	1

Appendix Table 4 (continued)

FIRM	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
SAP AG	1	1	1	1	1	1	1	1	1	1
SARTORIUS AG	1	1	1	1	1	1	1	1	1	1
SCHLOTT AG	1	1	1	1	1	1	1	1	1	1
SCHMALBACH-LUBECA AG	1	1	1	1						
SCHNIGGE AG		1	1	1	1	1	1	1	1	1
SCHULER AG		1	1	1	1	1	1	1	1	1
SCHWARZ PHARMA AG	1	1	1	1	1	1	1	1	1	1
SG HOLDING AG	1	1	1							
SGL CARBON AG	1	1	1	1	1	1	1	1	1	1
SIEMENS AG	1	1	1	1	1	1	1	1	1	1
SIXT AG	1	1	1	1	1	1	1	1	1	1
SKW TROSTBERG AG	1	1								
SM WIRTSCHAFTSBERATUNG AG		1	1	1	1	1	1	1	1	1
SOFTWARE AG		1	1	1	1	1	1	1	1	1
SPAR HANDELS-AG	1	1	1	1	1	1	1			
STADA ARZNEIMITTEL AG	1	1	1	1	1	1	1	1	1	1
STINNES AG		1	1	1	1					
STO AG	1	1	1	1	1	1	1	1	1	1
STRATEC BIOMEDICAL SYSTEMS AG	1	1	1	1	1	1	1	1	1	1
SÜDZUCKER AG	1	1	1	1	1	1	1	1	1	1
SURTECO SE		1	1	1	1	1	1	1	1	1
SYMRISE AG									1	1
TA TRIUMPH-ADLER AG	1	1	1	1	1	1	1	1	1	1
TAG IMMOBILIEN AG	1	1	1	1	1	1	1	1	1	1
TAKKT AG		1	1	1	1	1	1	1	1	1
TARKETT AG	1	1	1	1	1	1	1			
TECHEM AG			1	1	1	1	1	1	1	1
TECIS HOLDING AG	1	1	1	1						
TELEPLAN N.V.	1	1	1	1	1	1	1	1	1	1
TFG CAPITAL AG		1	1	1	1	1	1	1	1	1
THIELERT AG								1	1	
THYSSENKRUPP AG	1	1	1	1	1	1	1	1	1	1
TRIPLAN AG				1	1	1	1	1	1	1
TUI AG	1	1	1	1	1	1	1	1	1	1
TURBON AG	1	1	1	1	1	1	1	1	1	1
UZIN UTZ AG	1	1	1	1	1	1	1	1	1	1
VARTA AG	1	1	1	1	1	1	1	1	1	1
VCL FILM + MEDIEN AG		1	1	1	1	1	1	1	1	1
VEBA AG	1	1								
VIAG AG	1	1								
VICTORIA VERSICHERUNG AG	1	1	1	1	1					
VILLEROY & BOCH AG	1	1	1	1	1	1	1	1	1	1
VIVA MEDIA AG			1	1	1	1				

Appendix Table 4 (continued)

FIRM	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
VIVACON AG				1	1	1	1	1	1	1
VIVANCO GRUPPE AG		1	1	1	1	1	1	1	1	1
VOGT ELECTRONIC AG	1	1	1	1	1	1	1	1	1	1
VOLKSWAGEN AG	1	1	1	1	1	1	1	1	1	1
VOSSLOH AG	1	1	1	1	1	1	1	1	1	1
VTG-LEHNKERING AG	1	1	1	1	1					
W.E.T. AUTOMOTIVE SYSTEMS AG	1	1	1	1	1	1	1	1	1	1
WACKER CHEMIE AG									1	1
WALTER AG	1	1	1	1	1	1	1			
WASHTEC AG	1	1	1	1	1	1	1	1	1	1
WCM BETEIL.U.GRUNDBESITZ AG	1	1	1	1	1	1	1			
WEDECO AG		1	1	1	1	1				
WELLA AG	1	1	1	1	1	1	1	1		
WIGE MEDIA AG			1	1	1	1	1	1	1	1
WINCOR NIXDORF AG							1	1	1	1
WINKLER + DÜNNEBIER AG	1	1	1	1	1	1	1	1	1	1
WMF AG	1	1	1	1	1	1	1	1	1	1
WÜNSCHE AG	1	1	1							
ZAPF CREATION AG		1	1	1	1	1	1	1	1	1